WAVETEK

INSTRUCTION MANUAL

MODEL 154

PROGRAMMABLE WAVEFORM GENERATOR

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PRODUCT IMPROVEMENT NOTICE

Wavetek maintains a continuing program to make improvements to their instruments that will take advantage of the latest electronic developments in circuitry and components.

Due to the time required to document and print instruction manuals, it is not always possible to incorporate these changes in the manual.

Wavetek has manufactured your instrument, using metal film 1% tolerance resistors in place of 5% carbon resistors, wherever practical. This results in a substantial improvement in the overall performance of your instrument. Therefore, there may exist a discrepancy between the resistor used to manufacture your instrument and the resistor called out in the Parts List and Schematic Diagrams in this manual.

If field replacement of an affected resistor does become necessary, replacement may be made in accordance with the manual call outs. Wavetek, however, recommends replacement with the same type of resistor used in the manufacture of your instrument, whenever possible.

For greater flexibility in interconnections, all input BNC connectors are now duplicated to allow either front panel or rear panel connections. For correct operation, either the front or rear BNC of a given input can be used, but not both at the same time.

SAFETY

This instrument is wired for earth grounding via the facility power wiring. Do not bypass earth grounding with two wire extension cords, plug adapters, etc.

BEFORE PLUGGING IN the instrument, comply with installation instructions.

MAINTENANCE may require power on with the instrument covers removed. This should be done only by qualified personnel aware of the electrical hazards.

The instrument power receptacle is connected to the instrument safety earth terminal with a green/yellow wire. Do not alter this connection. (Reference: ⏚ or ⚠ stamped inside the rear panel near the safety earth terminal.)

WARNING notes call attention to possible injury or death hazards in subsequent operations.

CAUTION notes call attention to possible equipment damage in subsequent operations.

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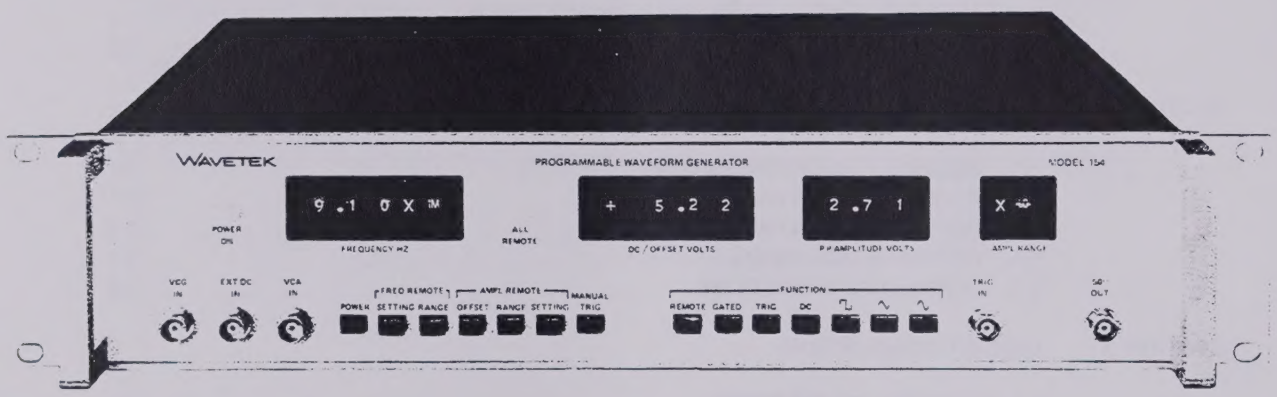


Figure i — Model 154 Programmable Waveform Generator

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of this instrument. Wavetek's product improvement program ensures that the latest electronic developments are incorporated in all Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print instruction manuals, it is not always possible to incorporate the more recent changes in the released manual. In this case, data will be found on engineering change sheets at the rear of the manual. If no change sheets are included, the manual is correct as printed.

SECTION 1
INTRODUCTION

1.1 GENERAL CAPABILITIES

The Model 154 Programmable Waveform Generator is a precision source of sine, square and triangle waveforms covering a frequency range from 0.001 Hz to 10 MHz. In addition, a calibrated, programmable dc voltage output is provided. Amplitude, frequency and dc level may be digitally programmed with three digit resolution. Amplitude, frequency and dc level may also be modulated by an analog control voltage. The generator may be operated in continuous, triggered or gated modes. All controls may be locally or remotely programmed. All programming is DTL/TTL compatible.

1.2 PHYSICAL AND ELECTRICAL SPECIFICATIONS

1.2.1 Versatility

Output Signals
DC voltage, Sine ∿ , Square ⊓ and Triangle △ selectable, with auxiliary pulse output.

Frequency Range
0.001 Hz to 10 MHz in 10 decade ranges, with 3 digit resolution.

Main Output
DC voltage, ±0.1 Vdc to 10 Vdc at 100 mA maximum. Output impedance less than 1Ω. ∿ , ⊓ , △ , 0.001 V peak to peak to 10 V peak to peak into 50Ω load. Output impedance 50Ω. All waveforms may be offset 5 V above or below ground level with 3 digit resolution and selectable polarity. Signal level plus offset voltage not to exceed ±7.5 V peak into 50Ω load.

Auxiliary Output
50% duty cycle pulse at generator frequency. Fixed amplitude, 0 to +6 V peak into open circuit (0 to 3 V into 50Ω).

Operating Modes
Continuous, trigger, or gated mode, selectable. The generator may be triggered to produce single cycles by pushbutton trigger or external trigger command. Any discrete number of cycles will be produced by applying a gate signal for the desired burst width when in the gated mode. Minimum voltage required for trigger = +3 V. 50 V can be applied without damage.

Analog Modulation Control
The frequency, amplitude and dc offset level of the generator can be independently controlled by an external voltage. The control can be dc programming or wideband modulation.

1.2.2 Accuracy

Horizontal Precision
Frequency accuracy of the generator, whether programmed manually with front panel switches or remotely by external digital programming:

0.001 Hz to 100 kHz	±(1% of setting +1 digit)
100 kHz to 1 MHz	±(1% of full scale)
1 MHz to 10 MHz	±(2% of full scale)

Vertical Precision
∿ and ⊓ Waves

0.001 Hz to 100 kHz	±(1% of setting +1 digit)
100 kHz to 1 MHz	±(2% of setting +1 digit)
1 MHz to 10 MHz	±(5% of setting +1 digit)

△ Wave

0.001 Hz to 10 kHz	±(1% of setting +1 digit)

Vertical precision stated is for X1 amplitude multiplier. For X0.1, X0.01 and X0.001 add 1% per step.

DC Voltage
±(1% of setting +1% of full scale).

DC Offset
±(1% of setting +1% of range).

1.2.3 Waveform Purity

Stability

Short term	±0.05% for 10 minutes
Long term	±0.25% for 24 hours

Percentages apply to frequency, amplitude and dc offset stability.

Time Symmetry
1% to 500 kHz.

Amplitude Symmetry
All waveforms to 500 kHz are symmetrical about ground within ±1% of range maximum p-p amplitude.

Sine Distortion

10 Hz to 100 kHz	Less than 0.5%
0.001 Hz to 1 MHz	Less than 1.0%
1 MHz to 10 MHz	All harmonics at least −28 dB

Square Wave
Auxiliary output better than 5 nanosecond rise and fall time with less than 5% aberrations. Main output better than 35 nanosecond rise time with aberrations less than 5% ±10 mV.

Triangle Linearity
Greater than 99%, 0.01 Hz to 100 kHz.

DC Voltage
Ripple and noise less than 10 mV rms with generator idle.

1.2.4 Analog Control Characteristics

Voltage Control of Frequency (VCG)
Up to 1000:1 frequency change with an external voltage input of 5 volts. The upper frequency is limited to maximum of selected range. VCG input impedance 3.3 kΩ.

VCG Response
Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

VCG Linearity

1.0 Hz to 100 kHz	±0.2% of full scale
0.001 Hz to 1 MHz	±0.5% of full scale

Voltage Control of Amplitude (VCA)
Full amplitude control with an external voltage input of ±5 volts. The control is bipolar, that is, the amplitude can be controlled from maximum through null to range maximum at inverted phase. VCA input impedance is 3.3 kΩ.

VCA Response
Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

VCA Linearity
1% of full scale.

Voltage Control of DC Offset
All waveforms may be offset above or below ground level by an external voltage. Sensitivity of the signal is +2 or −2 volts offset per volt input dependent on dc polarity selected. Input impedance is 3.3 kΩ. Signal level plus offset voltage not to exceed ±7.5 volts peak into 50Ω load.

DC Offset Response
Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

DC Offset Linearity
1% of full scale.

1.2.5 Environmental

Specifications apply at 25°C ±5°C. For operation from 0°C to +50°C, derate all specifications by a factor of 2. Instrument may be stored from −50°C to +80°C without damage.

1.2.6 Mechanical

Dimensions
19-inch rack mount panel, 3½ inches high, 16½ inches deep.

Weight
15 lb. net, 24 lb. shipping.

Power
105 V to 125 V or 200 V to 250 V; 50 to 400 Hz; less than 45 watts.

NOTES

All specifications apply for control settings from 1.00 to 9.99.

On 1 MHz range only X1 and X0.1 amplitude settings apply.

1.3 PROGRAMMING

Description
All functions may be remotely controlled by BCD logic level programming. Front panel push button switches can be used to select local (front panel) control or remote control. When all controls are in the remote position, a logic voltage output is enabled for computer verification as well as illumination of a front panel light for visual verification. Signal ground and program ground are isolated.

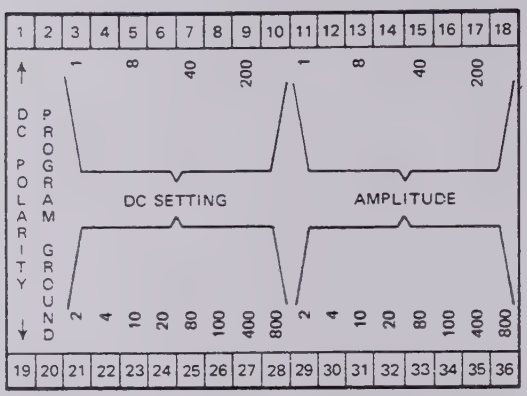
Program Requirements

Frequency	3 digits	12 lines
Frequency Range	10 ranges	4 lines
Amplitude	3 digits	12 lines
Amplitude Range	4 ranges	2 lines
DC Level	3 digits	12 lines
DC Polarity	0, + or −	2 lines
Function	∿ , ⊓ , ⩘ or dc	2 lines
Mode	Cont. Trig or Gate	2 lines
Output	Front or rear panel	1 line
Return		2 lines
All remote	Output for verification	1 line
Total No. of Lines for Complete Control		52 lines

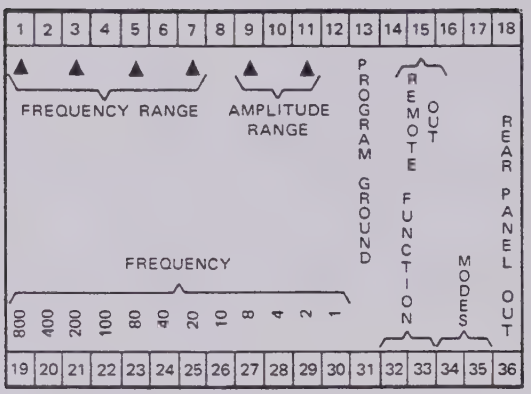
Program Transition Time
Frequency, amplitude and dc offset settings respond in less than 100 μs. Frequency range, function, offset polarity and attenuator respond in less than 3 ms.

CONTROL CONNECTOR PIN LAYOUT

Plug J2 Mating Connector Amphenol 57-30360



Plug J3 Mating Connector Amphenol 57-30360



Standard Control Logic

Logic 1 = +2.4 V to +10 V, typical sink current 1.5 mA per line.

Logic 0 = −1 V to +1 V, open circuit voltage is approximately −0.7 V.

TRUTH TABLES WITH PIN ASSIGNMENTS

DC Polarity	Program (Pin No.) 19 1
+	0 0
0	0 1
−	1 0

Frequency Range	Program (Pin No.) 7 5 3 1
0.001	0 0 0 0
0.01	0 0 0 1
0.1	0 0 1 0
1.0	0 0 1 1
10	0 1 0 0
100	0 1 0 1
1 K	0 1 1 0
10 K	0 1 1 1
.1 M	1 0 0 0
1 M	1 0 0 1

Amplitude Range	Program (Pin No.) 11 9
0.001	0 0
0.01	0 1
0.1	1 0
1.0	1 1

Function	Program (Pin No.) 33 32
∿	0 0
∿	0 1
DC	1 0
⊓	1 1

Mode	Program (Pin No.) 35 34
Continuous	0 0
Gated	0 1
No Output	1 0
Trigger	1 1

2. **Frequency Hz Setting** — A three-digit thumbwheel switch is provided for output frequency selection. For the actual output frequency, this value is multiplied by the frequency Hz range multiplier (3).

3. **Frequency Hz Range Multiplier** — This thumbwheel switch has ten decade ranges from 1 millihertz to 1 megahertz. This value multiplied by the setting (2) gives the output frequency.

4. **All Remote Indicator** — When all the front panel remote push buttons are in (button Nos. 13, 14, 15, 16, 17 and 19, see Fig. 2-1), the indicator is illuminated. This means the generator is completely controlled by remote programming and independent of the front panel controls. In this condition a signal (> +3 Vdc) appears at pin 15 of plug J3 for computer notification.

5. **DC/Offset Polarity** — When in the dc mode, this switch determines the polarity of the dc level, either + or —. When in the "0" position, the dc level will always be zero. When in the ∿ , ⊓ , or ⩘ function, this switch controls the polarity of the offset. When in the "0" position, the offset will always be zero.

6. **DC/Offset Volts** — This three-digit thumbwheel switch sets the dc level when in the dc mode, or the amount of dc offset into a 50Ω load for the waveform functions. The maximum voltage of the output amplifier is limited to ±7.5 volts into 50 ohms; therefore, the peak signal amplitude plus the offset should not exceed this limit or a distorted waveform will be the result. When in the dc mode, the output dc voltage is dependent only on the setting of this switch and independent of the p-p amplitude volt and amplitude range settings and also independent of the load current up to 100 milliamps.

7. **P-P Amplitude Volts** — This three-digit thumbwheel switch is used to set the peak to peak signal level into a 50 ohm load. It controls the level for the sine, triangle and square waves, but has no control in the dc mode.

8. **Amplitude Range** — This switch has four ranges, 1.0, 0.1, 0.01, and 0.001, allowing output amplitudes from 9.99 volts to 1 millivolt.

9. **VCG IN (Voltage Controlled Generator)** — This connector allows external analog control of frequency. Up to a 1000:1 frequency change may be obtained. A positive voltage increases frequency and a negative voltage decreases frequency. See section under OPERATION for details.

10. **EXT DC IN (External DC Offset Control)** — This input allows external analog control of dc offset or of dc voltage output. Sensitivity of the input is +2 or —2 volts offset per 1 volt input dependent on dc polarity selected; i.e., a gain of two. The small signal bandwidth is 100 kHz and the slew rate is 2% of range per microsecond.

    The EXT DC IN connector operates in conjunction with any manually or remotely programmed dc level or offset. The signals will be added or subtracted depending on the polarities. If the polarity switch (see 5) is in the "0" position, the EXT DC IN connector is disabled.

11. **VCA IN (Voltage Controlled Amplitude)** — The output amplitude can be modulated by an analog voltage input to this connector. This input signal is algebraically summed with the p-p amplitude setting on the front panel or with the remote program. This input may be used for studying most amplitude modulation techniques.

12. **Power** — Depressing this push button switch turns the unit on.

13. **Frequency Remote, Setting** — The frequency setting (see No. 2) will be controlled by the remote program when this switch is depressed. This does not affect the range multiplier. The setting is 0.00 if the control lines are open and the switch is depressed.

14. **Frequency Remote, Range** — Depressing this switch causes the frequency range to be selected by the remote program. The range will stay at X0.001 if the control lines are open and the switch is depressed.

15. **Amplitude Remote, Offset** — When this push button switch is depressed, the dc voltage output or signal dc offset, including the polarity, is controlled by the remote program. The setting will be +0.00 if the control lines are open and the switch is depressed.

16. **Amplitude Remote, Range** — The amplitude range is remotely controlled when the push button switch is depressed. The range will stay at X0.001 if the control lines are open and the switch is depressed.

17. **Amplitude Remote, Setting** — Depressing this switch causes the amplitude setting to be controlled by the remote program. The setting will be 0.00 with the button depressed and the control lines open.

18. **Manual Trigger** — The manual trigger button operates when the generator is in either triggered or gated mode (see Nos. 20 and 21). In the triggered mode,

one cycle of the selected waveform is generated each time the button is depressed. In the gated mode, the generator will continue to oscillate while the button is depressed. Upon releasing the trigger button, the generator will complete the last cycle and stop oscillating.

19. **Function Remote** — When this button is depressed, all of the modes under the function heading (Nos. 20 - 25) are under remote control. If this switch is depressed and the control lines are open, the output waveform will be a sine wave in the continuous running mode.

20. **Gated Mode** — When this switch is depressed, the generator may be started by applying a gating signal of at least 3 volts to the TRIG IN connector (see No. 26). Removing the gating signal causes the generator to complete the last cycle and stop. The generator may also be gated by depressing the manual trigger button (see No. 18).

21. **Trigger Mode** — In this mode the generator will produce one cycle of output for each trigger signal applied. The frequency of the trigger signal should be lower than the generator frequency. The trigger signal must be at least 3 volts. If both the gated and trigger switches are depressed, the generator will be in the triggered mode.

22. **DC** — Depressing this button causes a dc output to be present at the 50Ω output connector (see No. 27). The output impedance in the dc mode is 1 ohm. The maximum amount of dc is 10 volts and is set by the dc volts thumbwheel switch (see No. 6). The polarity is determined by the dc polarity switch (see No. 5). The polarity must be + or — for an output. Neither the p-p amplitude (see No. 7) nor the amplitude range multiplier (see No. 8) control has any effect on the dc output. The loading current should not exceed 100 milliamps.

23. ⊓⊔ **(Square Waveform)** — Depressing this button produces a square wave at the 50Ω output connector. Amplitude is controlled by the p-p amplitude volt and amplitude range switches (see Nos. 7 and 8), frequency by the frequency Hz setting and range multiplier switches (see Nos. 2 and 3).

24. ∿ **(Triangle Waveform)** — This switch applies a triangle waveform to the 50Ω output connector.

25. ∿ **(Sine Waveform)** — Depressing the button applies a sine wave to the 50Ω output connector.

26. **TRIG IN** — This connector accepts the trigger input signal for operation in either the trigger or gated mode (see Nos. 20 and 21). The trigger signal should be at least 3 volts. The input is dc coupled with 10K ohm impedance. Up to a 50 volt signal may be applied without damage.

27. **50Ω OUT** — This is the main output connector for all output signals. The signal will always be here unless the generator has been programmed to direct the output to the rear connector.

28. **AUX OUT** — This is an auxiliary pulse output. It is 0 to +6 volt pulse with 50% duty cycle. It can be used as a pulse, sync or squarewave output. It runs at the same frequency as the main generator. The rise and fall time is less than 5 nanoseconds.

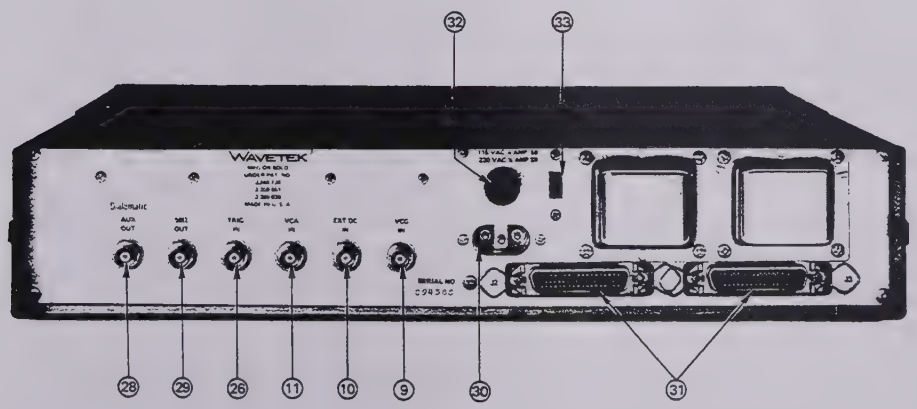


Figure 2-2. Operating Controls, Rear Panel

29. **50Ω OUT** — The main output is shifted to the rear output connector when pin No. 36 of connector J3 is programmed with a +2.4 V to +10 V signal. (See Section 1.3.)

30. **Power In Receptacle** — This connector accepts a female power cord for applying 120 or 240 volts ac.

31. **Remote Programming Connectors** — Remote control signals are input to the generator through these connectors. All control logic is BCD. (See Section 1.3 for pin assignments.) The mating connector (Part No. 57-30360) is manufactured by Amphenol.

32. **Line Fuse** — This fuse protects the instrument from ac line transients as well as shorts within the instrument. For 115 Vac operation, use a ½ amp slow blow fuse. For 230 Vac, use a ¼ amp slow blow fuse.

33. **115 - 230 Volt Switch** — This switch selects the power input voltage used. The instrument is normally shipped for 115 Vac and a ½ amp fuse. To convert to 230 Vac, set slide switch to 230 and install a ¼ amp slow blow fuse.

2.4 INSTALLATION CHECKS

This paragraph outlines a quick checkout procedure to determine if the instrument is operating properly. Field calibration and checkout instructions are given in Section 4 to determine compliance with electrical specifications. If electrical deficiencies exist, refer to the warranty on the back of the title page.

Use a Tektronix Model 454 oscilloscope (or equivalent) and a 10 MHz counter-timer with 4-digit resolution when performing these installation checks.

1. Connect the line cord to the ac line.

2. Connect the 50Ω OUT BNC to oscilloscope with 50 ohm cable terminated with 50 ohms.

3. Set frequency Hz to 1.00 X 1K.

4. Set DC/OFFSET VOLTS to 0 0.00.

5. Set P-P AMPLITUDE VOLTS to 1.00.

6. Set AMPL RANGE to X1.0.

7. Set generator up for complete manual control; that is, see that none of the remote buttons is depressed.

8. Depress ⊓ push button.

9. Depress POWER push button.

10. Observe a 1 volt p-p square wave at 1 kHz on the oscilloscope.

11. Depress ∧ and then ∿ push buttons. Observe triangle and sine waveforms, respectively.

12. Depress TRIG push button. Press MANUAL TRIG button several times and observe single cycle generation. Return TRIG button to out position.

13. Depress GATED push button. The generator should run as long as the MANUAL TRIG button is depressed. Return GATED button to out position.

14. With FUNCTION still on ∿ and amplitude at 1.00 X 1.0, set DC/OFFSET VOLTS to +5.00. Rotate most significant decade from 5 to 0. Change polarity to —. Rotate same switch from 0 to 5. Observe sine waveform being offset, first positively, then decreasing to zero and then increasing negatively over the range of ±5 volts. See Section 2.3, number 6, for signal plus offset limitations on the output amplifier. Return DC/OFFSET VOLTS to 0 0.00.

15. Set P-P AMPLITUDE VOLTS to 9.99. Rotate most significant decade from 9 to 0 and note proper operation of amplitude setting control.

16. Return P-P AMPLITUDE VOLTS to 9.99. Rotate AMPL RANGE control through all positions and note 20 dB change in amplitude per step. Return AMPL RANGE control to X1.0.

17. Remove 50 ohm terminator. Reconnect scope. Depress DC push button. Set DC/OFFSET VOLTS to +9.00. Observe 9 volt dc level. Rotate most significant decade of DC/OFFSET VOLTS thumbwheel switch from 9 to 0 and observe dc level decrease. Set polarity to — and rotate the same digit from 0 to 9. Observe dc level increasing negatively. Return DC/OFFSET VOLTS to 0 0.00.

18. Disconnect output BNC cable to oscilloscope and reconnect to a counter with 50 ohm terminator.

19. Rotate frequency setting and range multiplier switches and observe counter to verify proper frequency calibration.

20. Remote programming may be checked by applying dc levels (+2.4 to +10 V) to the appropriate pins of plugs J2 and J3 to verify that the output is correct. Use the Truth Tables with Pin Assignments in Section 1.3 to

determine which pins must receive a signal for a specified output.

2.5 OPERATING PROCEDURE

No preparation for operation is required beyond completion of the initial installation checks given in paragraph 2.4 of this manual. It is recommended that a one-half hour warm-up period be allowed for the associated equipment to reach a stabilized operating temperature and for the Model 154 to attain stated accuracies.

2.5.1 Operation as a Function Generator

1. Properly terminate the 50Ω OUT connector with 50Ω ±1% termination.

2. Select the desired waveform either from the front panel push buttons or by the remote program. If the remote mode is used, the FUNCTION REMOTE push button must be depressed.

3. Set FREQUENCY HZ setting and range multiplier for desired output frequency. If a remote program is used, be sure FREQ REMOTE SETTING and/or RANGE push buttons are depressed as required.

4. Set P-P AMPLITUDE VOLTS and AMPL RANGE multiplier for desired output amplitude. If a remote program is used, depress either or both AMPL REMOTE RANGE and SETTING push buttons as desired.

5. A positive or negative dc offset may be applied to the waveform by setting the DC/OFFSET VOLTS to the desired level. The peak signal value plus the offset cannot exceed ±7.5 volts. If it is desired to control the offset by the remote program, the AMPL REMOTE OFFSET push button must be depressed.

2.5.2 Operation as a Voltage Controlled Generator

The VCG input connector can be used to externally control the frequency of the generator. If a positive voltage is applied to the VCG input terminal, the frequency will increase from the dial setting. A negative voltage will cause the frequency to decrease from the dial setting. The VCG range of the Model 154 is 1000:1. The nomograph of Figure 2-3 shows the characteristics of the VCG circuit. Column A gives the frequency setting, column B, the VCG voltage and column C, the resultant frequency of the generator.

The following are examples of setting up the generator for several ranges of frequency change.

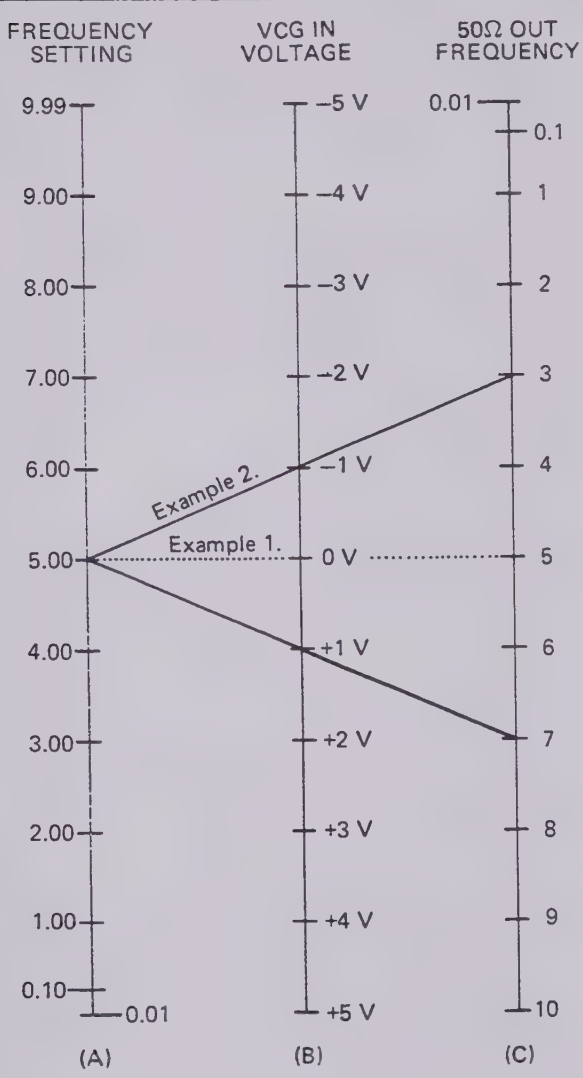


Figure 2-3. VCG Voltage-to-Frequency Nomograph

In example 1, the frequency setting is 5.00 and 0 volts VCG input voltage is applied. Extend a straight line from 5.00 (frequency setting) through 0 volts (VCG voltage). The result is an output frequency of 5 (multiplied by the range multiplier).

In example 2, the frequency setting is 5.00 and a varying VCG voltage of −1 V to +1 V is applied. By extending straight lines through the appropriate position it can be seen that the frequency will vary from 3 to 7 (multiplied by the range multiplier).

To obtain a maximum frequency change of 1000:1 the low frequency must have a setting of 0.01 X the multiplier. The maximum top frequency will then be 9.99 X the multiplier, thus giving a 1000:1 change.

For example, suppose an increasing sweep from 10 kHz to 10 MHz is desired. The VCG input must be a 0 to +5 volt ramp. The frequency setting must be 0.01 X 1M which equals 10 kHz (the low frequency). At a +5 volt input the generator will be at the full scale output (9.99 X 1M) or 10 MHz.

As another example, sweep down from 1 kHz to 1 Hz. The VCG input must be a 0 to −5 volt ramp. The frequency setting must be 9.99 X 100 which equals 1 kHz, the high frequency. At a −5 volt input the generator will be at the minimum allowed output for the X100 range (0.01 X 100) or 1 Hz. These examples may be verified by using the nomograph in Figure 2-3.

2.5.3 Operation as a Triggered Generator

1. Select the desired waveform by depressing the corresponding FUNCTION push button. If remote control is used, depress the FUNCTION REMOTE push button and program the remote connector as required.

2. Set or program generator to the desired frequency.

3. Depress the TRIG push button. If remote control is used, depress FUNCTION REMOTE. Apply +2.4 to +10 volt logic levels to pins 34 and 35 of plug J3. (See the Truth Tables in Section 1.3.)

4. Apply an external trigger signal of at least +3 volts to the TRIG IN connector or depress the MANUAL TRIG push button for generation of one cycle of the selected waveform. One cycle output will be generated for each input signal, providing the frequency of the trigger signal is lower than the generator frequency.

2.5.4 Operation as a Gated or Tone Burst Generator

1. Select the desired waveform by depressing the corresponding FUNCTION push button. If remote control is used, depress the FUNCTION REMOTE push button and program the remote connector as required.

2. Set or program generator to the desired frequency.

3. Depress the GATED push button. If remote control is used, depress FUNCTION REMOTE. Apply +2.4 to +10 volt logic level to pin 34. No signal is applied to pin 35.

4. Apply an external gating signal of at least +3 V to the TRIG IN connector or depress the MANUAL TRIG button. A gated or tone burst signal will be generated as long as gating signal is applied to TRIG IN or MANUAL TRIG is depressed.

2.5.5 Operation as a DC Voltage Source

Model 154 may be used as a calibrated dc voltage source not to exceed 100 mA of current as follows:

1. Set the generator in the triggered mode either by depressing the TRIG push button or by the remote program. See 2.5.3, Step 3. This inhibits the generator from running which minimizes the noise content of the dc.

2. Set the function to DC either locally or by remote program. The output impedance at the 50Ω OUT connector is now less than 1 ohm.

3. Connect the 50Ω OUT connector to the device under test.

4. Set or program the DC/OFFSET VOLTS to the desired value, either positive or negative. The dc voltage ranges from 9.99 to 0.01. The ripple and noise is less than 10 mV with the generator idle.

2.5.6 Operation as an Amplitude Modulated Generator

The VCA IN connector provides an input for amplitude modulation. In using the VCA capability of the generator, refer to Figure 2-4.

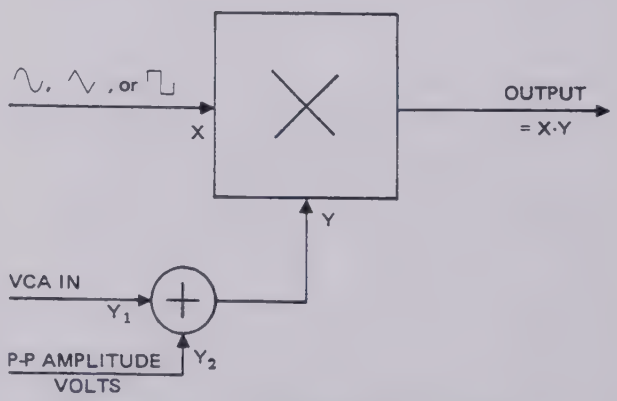


Figure 2-4. X-Y Multiplier Block Diagram

The output of the generator is the product of the X and Y inputs; that is, the generator signal times the sum of the VCA IN plus the p-p amplitude, or output = $X(Y_1 + Y_2)$. Y_2 is always a positive dc level, internal to the generator, which controls the output amplitude, if there is no VCA IN signal. Any VCA input, whether dc or ac, adds to Y_2. If the sum of Y_1 and Y_2 exceeds the output capabilities of the generator, a clipped waveform will result.

The modulated output of the generator with several different VCA input conditions is shown in Figure 2-5. The P-P AMPLITUDE VOLTS control is assumed to be 0.00.

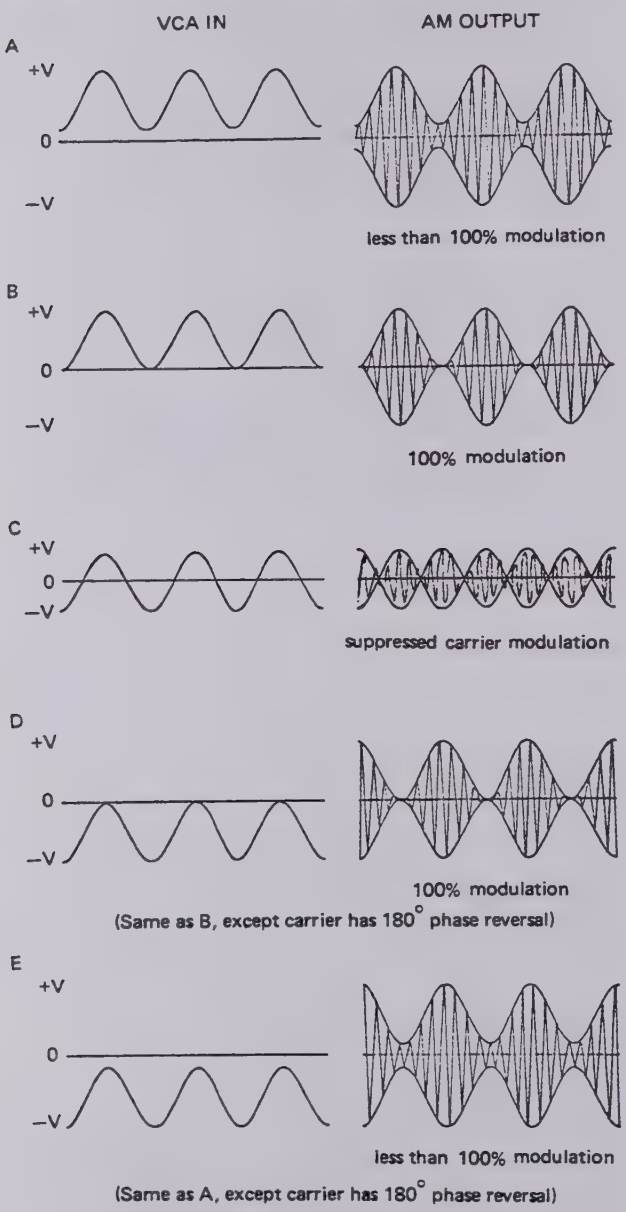


Figure 2-5. Amplitude Modulation Input and Resultant Output

The nomograph in Figure 2-6 is provided to determine the peak limits of the amplitude modulated output.

Example 1 displays suppressed carrier modulation. See Figure 2-5, Diagram C, for a display of the VCA input waveform and the resultant modulated output.

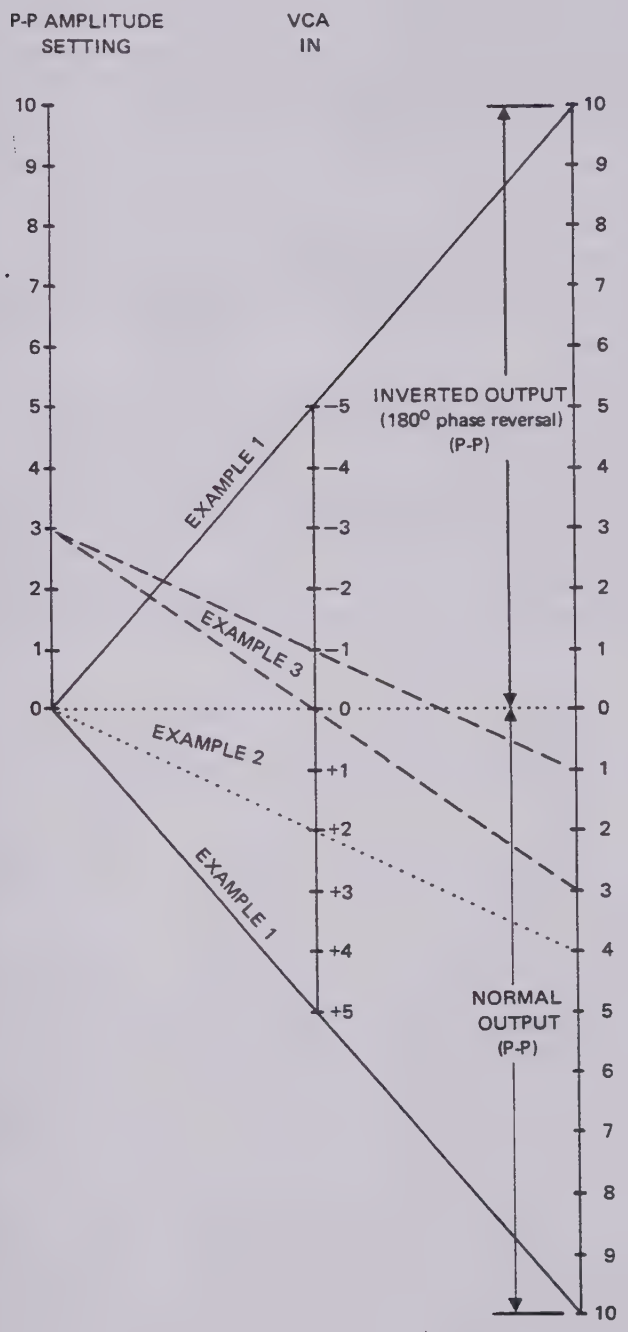


Figure 2-6. Amplitude Modulation Nomograph

Example 2 shows 100% modulation. The envelope is 4 volts peak to peak. The input sine wave is 2 volts p-p with the negative peak equal to zero as referenced to signal ground of the Model 154. See Figure 2-5, Diagram B, for waveform display.

Example 3 shows the effect of using the p-p amplitude control together with a VCA input. The result is less than 100% modulation, since the p-p amplitude control has offset the VCA input above signal ground. The effect is shown in Diagram A of Figure 2-5.

2.5.7 Remote Operation

The Model 154 may be partially or totally operated in the remote mode. Refer to Figure 2-1.

All of the following should be noted when using a remote program.

1. Be sure logic levels are compatible with those stated in Section 1.3.

2. Be sure plugs J2 and J3 are wired correctly according to the pin layout in Section 1.3.

3. Some or all functions may be programmed at any one time. See Section 2.3, paragraphs 13 through 19.

4. When the generator is completely under remote control, a front panel light will be illuminated as well as a signal generated at pin 15 of J3.

5. The analog program applied to the VCG IN, VCA IN and/or EXT DC IN are additive to the digital program.

6. The 50Ω OUT is normally at the front panel, but may be programmed to appear at the rear panel connector by applying a signal to pin 36 of connector J3. The waveform quality at high frequencies will be better at the front panel output.

CAUTION

At no time should voltage be applied to the instrument that will cause the potential between signal ground and program ground to exceed 10 Vdc.

SECTION 3
CIRCUIT DESCRIPTION

3.1. GENERAL DESCRIPTION

3.1.1 VCG Generator

A simplified block diagram of the VCG generator is shown in Figure 3-1. Triangle and square signals are generated simultaneously in the triangle generator circuit. The triangle is then applied to a sine converter and amplified.

The frequency is controlled by the current from the VCG amplifier which in turn is controlled by the voltage from the VCG D/A converter.

One of the signals, square, triangle, sine or DC, is fed into the X-Y multiplier and the amplitude is controlled by the VCA D/A converter.

The signal is then fed into the output amplifier. The amount of dc offset is controlled by the voltage from the dc offset D/A converter. The square wave from the triangle generator circuit is also fed into a fast switching circuit, a pulse amplifier, to generate a fixed amplitude fast square wave output.

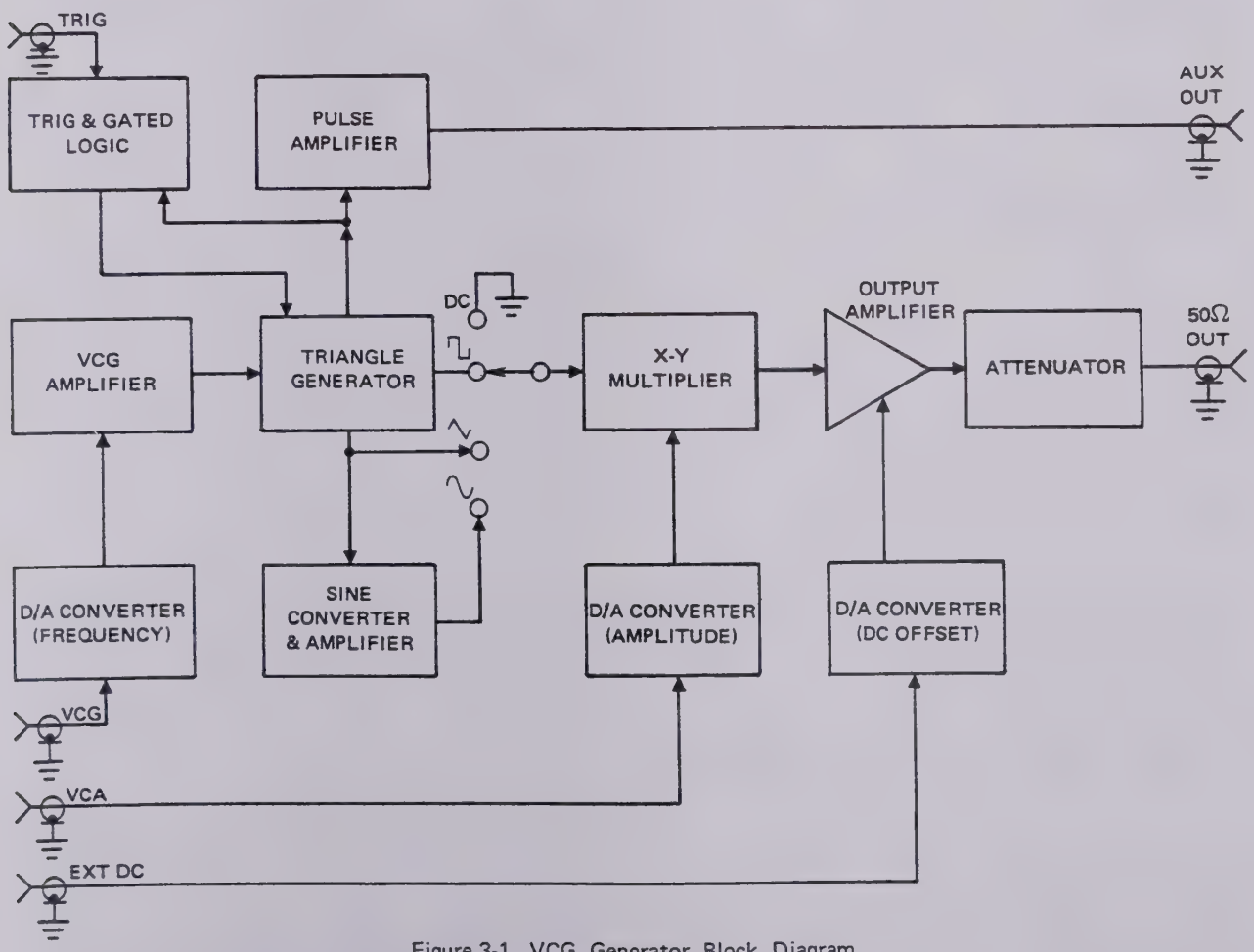


Figure 3-1. VCG Generator Block Diagram

3.2 THEORY OF OPERATION

3.2.1 Triangle Generator

When the voltage at point D is positive, the diodes CR15 and CR16 are reverse biased and CR14 and CR17 are forward biased. See Figure 3-2. Therefore, the current I+ is charging the capacitor C which causes the voltage at points A and B to rise. As soon as the voltage at point B reaches +1.25 V, the output of the hysteresis switch will switch negative and thus reverse the current flow. The current I− is drawn from capacitor C. Again, the hysteresis switch will switch positive when the voltage at B is below −1.25 V. Thus, triangle and square signals are generated simultaneously.

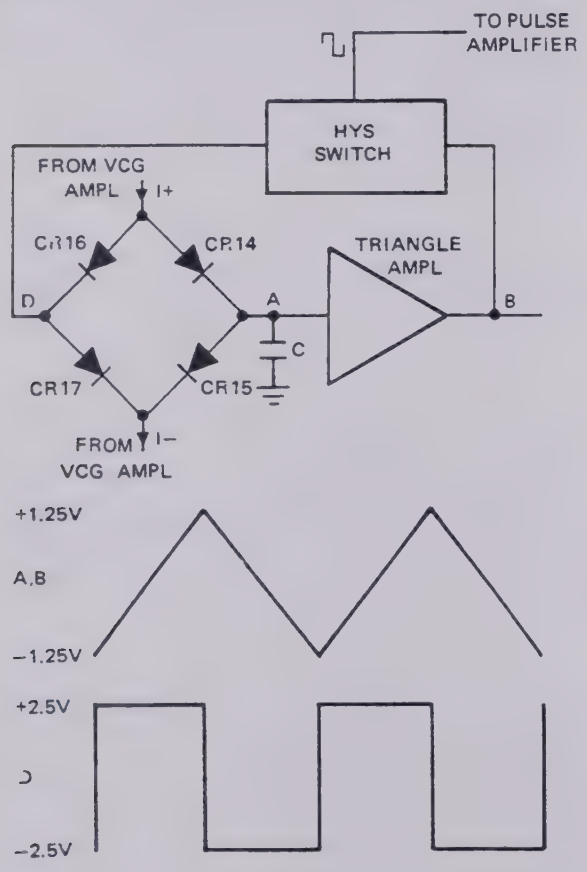


Figure 3-2. Triangle Generator Block Diagram

The output frequency depends on the size of the capacitor selected and the amount of currents, I+ and I−, charging the capacitor. The currents are controlled by the VCG amplifier which in turn is controlled by the voltage from the D/A amplifier and VCG input.

3.2.2 VCG Amplifier and Current Sources

The voltage used to control the output frequency from the D/A amplifier is applied to point A of the VCG amplifier. See Figure 3-3. Two ICs are used to shift the control voltage ground reference to the power supply reference. The other two ICs are the current source generators. The two current outputs are fed to the triangle generator.

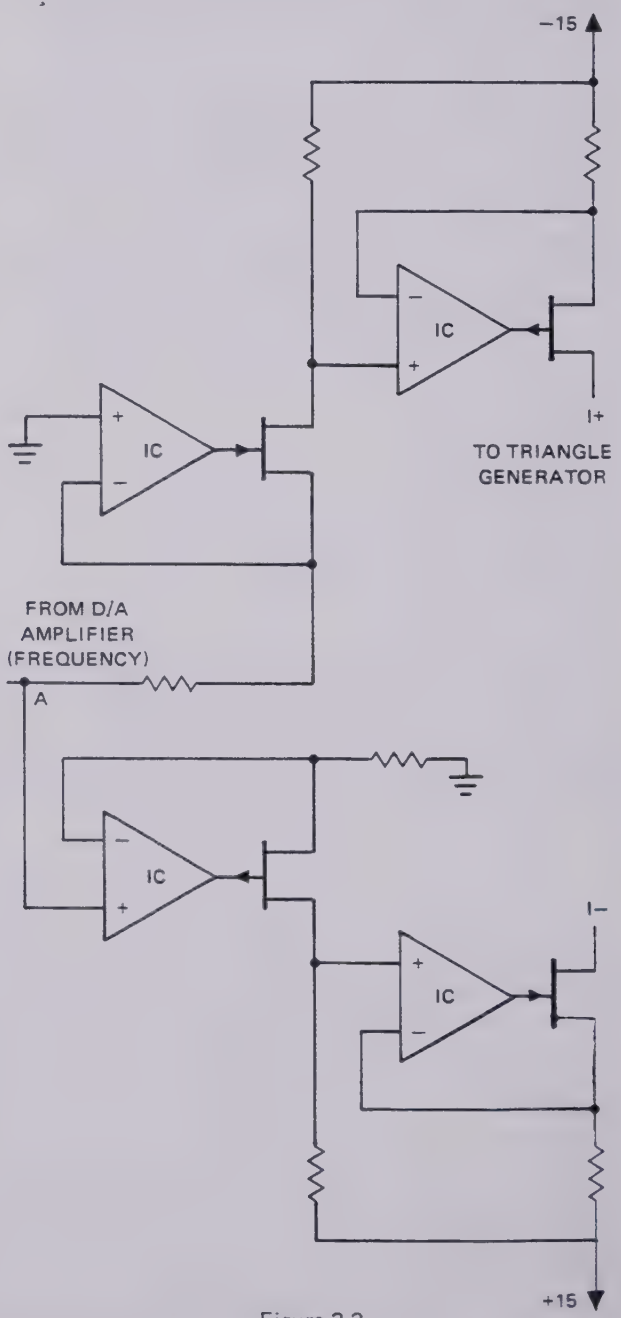


Figure 3-3.
VCG Amplifier and Current Source Simplified Circuit

3.2.3 Capacitance Multiplier

Frequency ranging is achieved by selecting different capacitors. For frequency ranges at X1 Hz or below, large capacitors are necessary and, therefore, impractical. Instead, a capacitance multiplier circuit is used, and ranging is achieved by changing the multiplication factor which is equivalent to the ranging resistors. The simplified circuit is shown in Figure 3-4.

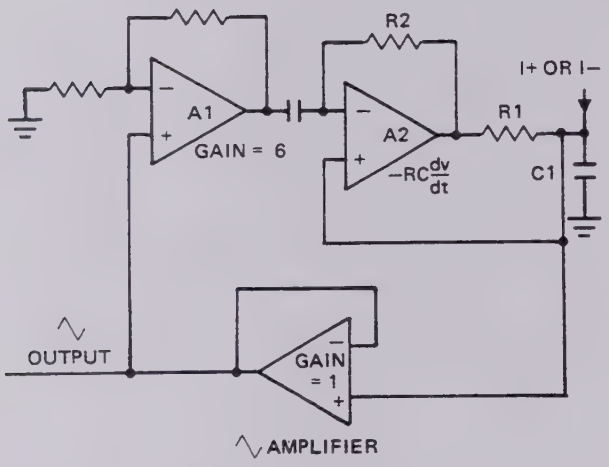


Figure 3-4. Capacitance Multiplier Simplified Circuit

Because of the nature of the feedback loop connection, A1 and A2, most of the current, I+ and I–, will be drawn by A2 through R1. Only a very small percentage of current is changing and discharging capacitor C1. Therefore, the output frequency will appear much slower. The percentage of current drawn by A2 is precisely controlled by the loop gain and time constant of the capacitance multiplier circuit. Frequency ranging is achieved by changing R2.

3.2.4 X-Y Multiplier and Output Amplifier

One of the signals is selected and fed into one input of the X-Y multiplier, and a control voltage from the D/A amplifier is fed to the other input. Refer to Figure 3-5. The differential output from the X-Y multiplier is directly proportional to the product of two inputs.

The signal is then fed into the output amplifier which consists of two inverting amplifiers. The combined operation of the two amplifiers is exactly equal to one differential amplifier. Because of the large common mode rejection of this amplifier, the output amplifier ground, " ⏚ ", can be floated from all other grounds, " ⏚ ". A separate power supply would be required in this case.

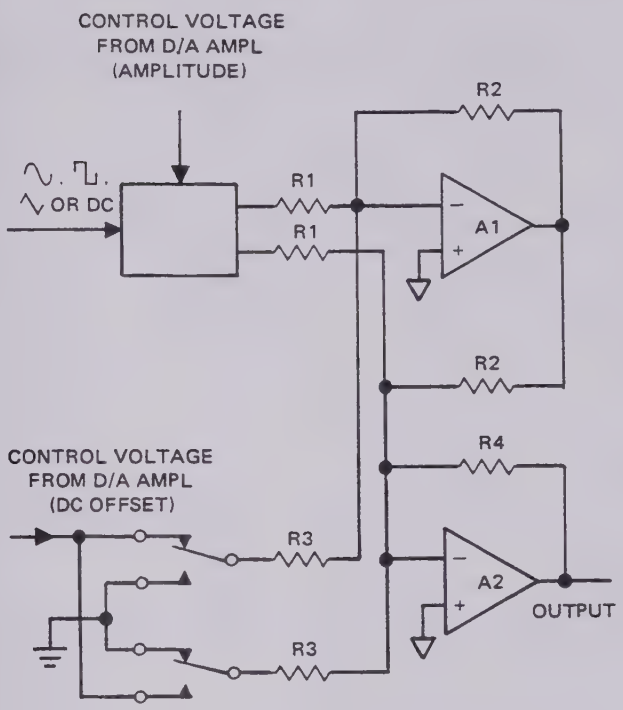


Figure 3-5.
X-Y Multiplier and Output Amplifier Simplified Circuit

3.2.5 Trigger Gated Modes

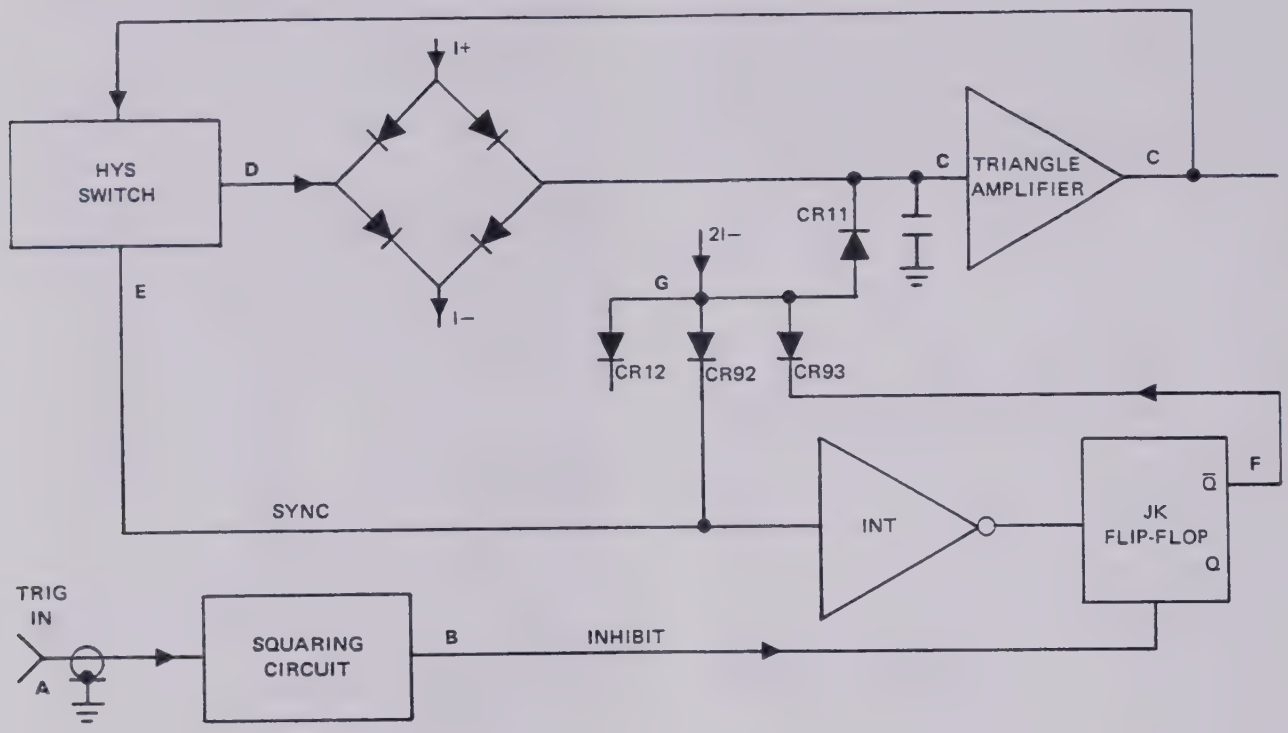
The triangle generator will oscillate continuously only if the voltage at **G** is negative which reverse biases CR11. Refer to Figure 3-6. This requires that the voltage at **E** or **F** be negative. If both voltages at **E** and **F** are positive, then so is the voltage at **G**. The current through CR11 will keep the voltage of **C** from falling below zero, because CR12 is clamped at zero. This stops the generator from oscillating.

The JK flip-flop is used to control the timing so that the triangle will always stop at the end of the cycle. The triangle will stop at time t_3, if the trigger signal is reset between times t_1 and t_3 as shown in the timing diagram.

If the signal at **B** is differentiated before it is applied to the JK flip-flop, only one cycle of the triangle signal will be generated for each trigger input.

3.2.6 D/A Converter

Diode gates are used to switch the voltage through weighting resistors into the summing node of an amplifier. Refer to the D/A Converter Schematic.



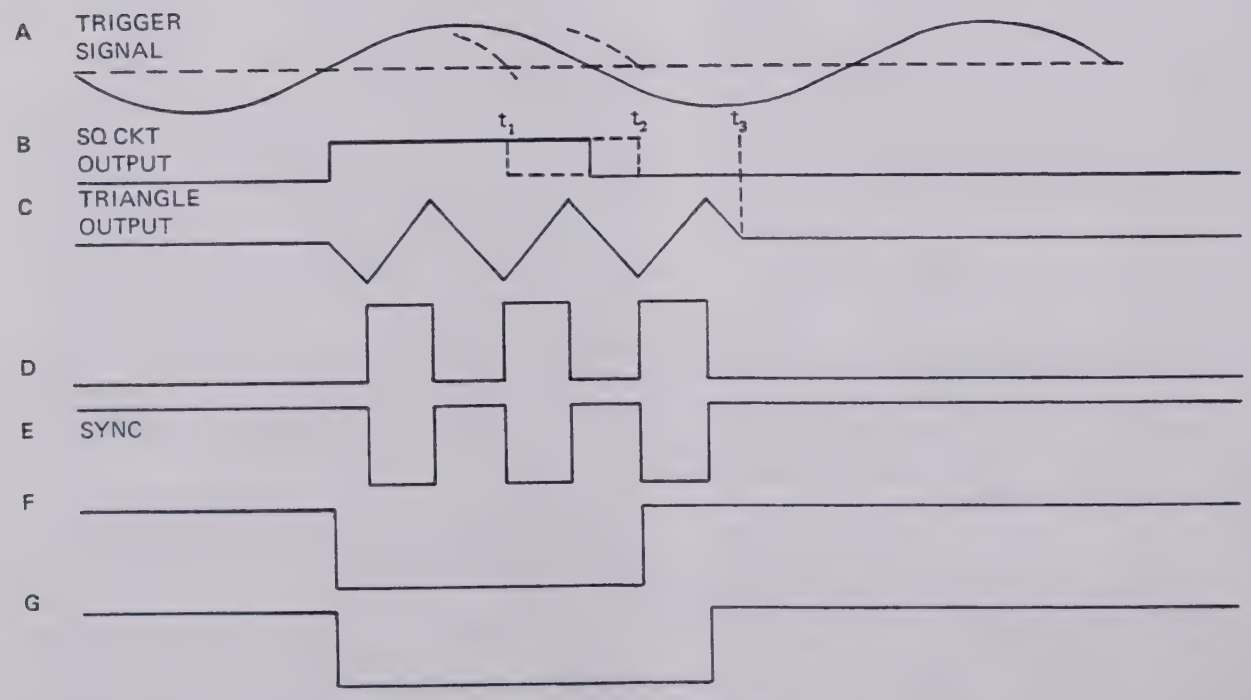


Figure 3-6. Trigger Gated Block and Timing Diagrams

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 INTRODUCTION

This section provides instructions for testing, calibrating, troubleshooting, and repairing the Model 154 generator. The instructions are concise and written for the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to facilitate the turnaround time. The main board test point and adjustment locations are shown on the board itself, and all points are illustrated in the data package.

4.2 ACCESS INSTRUCTION

Removal of the top dust cover affords quick access to all the components within the unit. However, it may be necessary to remove the bottom dust cover to replace the components.

An extender board (located in the front left corner) is provided to allow testing and repair of individual boards while still in the circuit. To remove the extender board, remove the two screws located on the side panel.

4.2.1 Removing the Dust Cover

1. Unplug the power cord.
2. Unscrew two captive screws on top cover.
3. Remove top cover.
4. Follow same procedure for bottom cover removal.

4.3 RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment. Any test equipment having equivalent accuracies may be substituted for those listed.

Table 4-1. TEST EQUIPMENT

Type	Required Characteristics	Recommended Manufacturer	Model
Oscilloscope	To 250 MHz	Tektronix	454
Oscilloscope	To 30 MHz	Tektronix	544
Plug-In	Dual Channel	Tektronix	1A1
Plug-In	Peak mV measuring capability	Tektronix	1A5
Distortion Analyzer	To 600 kHz	Hewlett-Packard	334A
Spectrum Analyzer Display	To 50 MHz	Hewlett-Packard	141S
IF Section		Hewlett-Packard	8552A
RF Section		Hewlett-Packard	8553L
Differential Voltmeter	Microvolt dc measurement		
Counter-Timer	To 10 MHz 0.1% of reading accuracy		

4.4 CALIBRATION INSTRUCTIONS

The following paragraphs provide complete sequential calibration procedures for the Model 154 generator.

NOTE

The entire calibration procedure must be read first to determine initial control settings and test equipment connections required before attempting recalibration. The steps of this procedure should be performed in the sequence given, and the parts within each step should also be performed in the same sequence given. **Fold out page 4-21 for Adjustment and Test Point Locations.**

NOTE

Unless otherwise noted, all measurements made at the 50Ω OUT connector should be terminated into a 50Ω load when in ∿ , ∿ , or ⊓ modes and unterminated when in DC.

4.4.1 Preliminary Procedures

Allow the unit to warm up for at least 30 minutes. Start the calibration by setting the front panel switches and controls as follows:

POWER Switch . . . . . ON (IN)
FUNCTION Switch . . . . . ∿
All other push button switches should be in the OFF (OUT) position.
FREQUENCY . . . . . 9.99 X 100
DC/OFFSET 0 0.00
AMPLITUDE . . . . . 5.00 X 1.0

4.4.2 Power Supply Regulation

1. Connect a voltmeter to R5 (marked "+15 V" in ∿ AMPL section of the main board), and ground at TP1 (C15).

2. Adjust voltage to +15 Vdc ±20 mV, using R21 on the 15 V power supply board.

3. Check for approximately −15 volts at R7 (marked "−15 V" in ∿ AMPL section of the main board).

4. Check for approximately +24 volts at R4 and −24 volts at R3 in ∿ AMPL section of the main board. Test points are marked "+24 V" and "−24 V".

5. Connect a voltmeter to +23 volts across C72 (OUTPUT AMPL section of main board). Adjust voltage to +23 Vdc ±20 mV using R21 on the 23 V power supply board.

6. Check voltage across C70 for −23 Vdc ±400 mV.

7. Check the +6 volt supply in AUX AMPL section of main board and ground at TP1 (C15). Voltage should be +6 Vdc ±200 mV.

4.4.3 Triangle Amplitude Adjustment

1. Use a type W or 1A5 plug-in module with the scope for this calibration. Connect the oscilloscope probe (X1) to output of the triangle amplifier at TP2 and ground at TP1 on the main board. Make sure the frequency setting is at 9.99 X 100 Hz.

2. Adjust the positive peak of the triangle to +1.25 V ±5 mV using R21 on the main board.

3. Adjust the negative peak of the triangle to −1.25 V ±5 mV using R11 on the main board.

4.4.4 Frequency Calibration

1. Set function to ⊓ and connect the main output to the scope.

2. Set frequency to 0.09 X 0.1M. Alternately short and open VCG IN to ground and adjust R34 on the D/A amplifier board until no frequency shifting can be observed on the scope.

3. Connect the main output to a counter and verify that the shifting is less than 100 Hz.

4. Set frequency to 0.01 X 10K. Adjust R29 on the D/A amplifier board for 100 Hz ±15 Hz. (VCG should not be shorted to ground.)

5. Connect the output to an oscilloscope. Adjust the time symmetry to within 1% using R7 on the VCG board. A dual channel counter set in the B−A mode may also be used for this calibration. By alternately changing the slopes from positive to negative on both channels, the asymmetry may be measured.

6. Set frequency to 9.99 X 10 kHz. Adjust output frequency to 99.9 kHz ±100 Hz using R40 on D/A amplifier board.

7. Set frequency to 8.99 X 1 MHz. Adjust frequency to 8.99 MHz ±25 kHz using C4 on main board. Trim C2 if necessary.

8. Set frequency to 9.99 X 10K. Re-adjust frequency to 99.9 kHz ±100 Hz using R40 on D/A amplifier board. Trim R31 on D/A amplifier board if necessary.

9. Set frequency to 0.01 X 10 kHz. Re-adjust output frequency to 100 Hz ±15 Hz using R29 on D/A amplifier board.

10. Check frequency accuracy from 1.00 × 1M to 9.99 × 1M. All frequencies should be within ±2.0% of full scale. If not, re-adjust C4. If adjusting C4 does not help, try to trim capacitors C16, C17, C22 and C23 on the main board. Add 5 to 10 pF capacitance at locations C16 and C23, if frequency at the 9.99 × 1 MHz setting is too low. Reduce 5 to 10 pF of capacitance at both C17 and C22, if frequency at the 9.99 × 1 MHz setting is too high.

11. Set frequency to 9.99 X 0.1M. Adjust frequency to 999 kHz ±1 kHz using C6 on the main board. Trim C8 if necessary.

12. Set frequency to 9.99 X 1K. Adjust output frequency to 9.99 kHz ±10 Hz using R39 on D/A amplifier board.

13. Set frequency to 9.99 X 100. Adjust output frequency to 999 Hz ±1 Hz (or period to 1001 μs ±1 μs) using R38 on the D/A amplifier board.

14. Set frequency to 9.99 X 10. Adjust output frequency to 99.9 Hz ±0.1 Hz (or period to 10.01 ms ±10 μs) using R37 on the D/A amplifier board.

15. Connect a scope probe to the output of the triangle amplifier at TP2 and ground at TP1 on the main board.

16. Set generator to TRIG mode with front panel switch. Set frequency to 9.99 X 10 Hz. Adjust the dc level to 0 Vdc ±3 mV using R2 on the main board.

17. Set generator back to continuous running, frequency to 0.50 X 1.0 Hz, and function to ⊓⊔ . Adjust the time symmetry at the 50Ω OUT connector to less than 0.2% using R47 on the VCG board. In addition to using sweep magnifier on scope for this calibration, a dual channel counter may be used as described in Step 5 of Section 4.4.4.

18. Set frequency to 9.99 X 1.0 Hz. Adjust output frequency to 9.99 Hz ±0.01 Hz (or period to 100.1 ms ±0.1 ms) using R15 on the VCG board.

4.4.5 X-Y Multiplier Adjustment

1. Set function to DC, frequency to 2.00 X 100 Hz, and DC/OFFSET to 0 0.00.

2. Make sure the 50Ω output ground is not shorted to program ground by measuring the voltage between the two grounds; i.e., the grounds of 50Ω OUT and TRIG IN.

3. Connect the 50Ω OUT to an oscilloscope. Alternately short and open the 50Ω ground to the TRIG IN ground. Adjust R153 on the main board at the same time until the dc level at the output changes less than 5 mV.

NOTE

In case the voltage across the two grounds is too small and the effect is not obvious, an external voltage less than 10 Vdc can be applied momentarily between the two grounds for the above calibration. R153 should be adjusted for a dc shift of less than 5 mV.

4. Adjust R117 on the main board so that the output dc level stays within 10 mV at the 0.00 and 9.00 settings of the P-P AMPLITUDE VOLTS control.

5. Set DC/OFFSET to 0 Vdc ±20 mV using R132 on the main board.

6. Set function to ∿ (frequency remains at 2.00 X 100 Hz) and P-P AMPLITUDE to 0.00.

7. Adjust the voltage between TP3 and TP1 (GND) on main board to 0 Vdc ±5 mV using R8 on the D/A amplifier board. TP3 is located at one end of R110 in the X-Y multiplier section on the main board.

8. Adjust the 50Ω OUT signal to minimum using R118 on the main board.

9. Set P-P AMPLITUDE to 0.05 V. Adjust R124 on main board for the most linear waveform.

10. Reset P-P AMPLITUDE to 0.00. Repeat Step 8.

11. Set function to DC with P-P AMPLITUDE and DC/OFFSET still at 0.00. Adjust dc voltage at 50Ω OUT to 0 Vdc ±20 mV into open circuit using R132 on the main board.

12. Set function to ∿ and P-P AMPLITUDE to 0.00. Repeat Step 8.

4.4.6 Sine Distortion Adjustment

1. Set function to ∿ , frequency to 9.99 X 100 Hz, and P-P AMPLITUDE to 9.99.

2. Connect a scope probe (X1) to the output of the sine amplifier at TP4 and ground at TP1. Connect the other end to a low frequency sine distortion analyzer.

3. Adjust sine distortion for minimum using R85, R86 and R88 on the main board. These pots interact so several adjustments of each pot may be necessary for minimum distortion.

4. Adjust for minimum sine distortion at 50Ω OUT using R120 on the main board.

5. Check sine distortion at 9.99 X 1 kHz. Re-adjust R85, R86 and R88, if necessary, to obtain optimum sine distortion at 999 Hz and 9.99 kHz.

6. Set function to DC, frequency to 2.00 X 100 Hz and DC/OFFSET to 0 0.00. Repeat Steps 4 and 11 in Section 4.4.5 (X-Y Multiplier Adjustment).

4.4.7 Output Amplitude and DC Offset Adjustment

1. Set function to DC and P-P AMPLITUDE to 0.00. Adjust R18 on the D/A amplifier board so that the dc level at the 50Ω OUT connector changes less than 10 mV at different dc polarity settings: "–", "0" and "+".

2. Set P-P AMPLITUDE to 9.99 V, function to ∿ and frequency to 9.99 X 100 Hz.

3. Adjust output amplitude to 9.99 V p-p ±10 mV into a precision 50Ω load using R10 on the D/A amplifier board.

4. Set function to ∿ . Adjust the amplitude to 9.99 V p-p ±10 mV using R108 on the main board.

5. Adjust the dc offset of ∿ output to less than ±10 mV using R93 on the main board.

6. Set function to ⊓ . Adjust the peak voltage to ±4.995 V ±5 mV using R57 and R54 on the main board for positive and negative peaks, respectively.

NOTE

If calibration cannot be achieved, trim R44 (on main board) so that the ⊓ signal at the emitter of Q13 is symmetrical about ground within 200 mV.

7. Set function to DC and DC/OFFSET VOLTS to +9.99. Adjust the output voltage at 50Ω OUT connector to +9.99 V ±10 mV using R22 on the D/A amplifier board without a load.

8. Switch DC/OFFSET VOLTS to –9.99. The output voltage should be –9.99 V ±60 mV. If not, re-adjust R22 to obtain optimum calibration.

9. Set function to ∿ , P-P AMPLITUDE to 0.00 and DC/OFFSET VOLTS to +4.99.

10. Adjust the dc offset at the 50Ω OUT connector to +4.99 V ±5 mV into a precision 50Ω load using R24 on the D/A amplifier board.

11. Switch the DC/OFFSET VOLTS to –4.99. The output voltage should be –4.99 V ±30 mV. If not, re-adjust R24 to obtain optimum calibration.

4.4.8 High Frequency Amplitude Response Adjustment

1. Set frequency to 1.00 X 1 MHz, DC/OFFSET to 0 0.00, P-P AMPLITUDE to 9.99 V, and function to ⊓ . Make sure that the output is loaded with a precision 50Ω load.

2. Adjust C75 and C77 on the main board for best looking square waveform.

3. Set function to ∿ . Adjust for best amplitude flatness to 10 MHz with 1 kHz as reference using C49 on the main board.

4.4.9 Trigger Baseline Adjustment

1. Set function to ∿ , frequency to 9.99 X 100 Hz, DC/OFFSET to 0 0.00, and P-P AMPLITUDE to 9.99 V. Generator should be in TRIG mode. Adjust output voltage to 0 Vdc ±10 mV using R2 on the main board.

2. Change frequency to 0.01 X 100 Hz. Adjust output voltage to 0 Vdc ±30 mV using R34 on the VCG board.

3. Change function to ∿ . Adjust output voltage to 0 Vdc ±10 mV using R93 on the main board.

4.5 CORRECTIVE MAINTENANCE

This portion of the manual presents a systematic approach to trouble-shooting. It is composed of two parts. Part one (see 4.5.1) is a quick guide for locating the area of the problem. Part two (see 4.5.2) contains 12 tables which are given as detailed supplements to part one.

The following abbreviations are used:

Symbol	Meaning
B	Base (transistor)
C	Collector (transistor)
E	Emitter (transistor)
G	Gate (FET)
S	Source (FET)
D	Drain (FET)
CR	Diode
Qn	Transistor number (n)
V_{GS}	Voltage between gate and source (FET)
Q	Output terminal (flip-flop)
$\bar{Q}$	Inverting output terminal (flip-flop)

4.5.1 Quick Trouble-Shooting Guide

Symptom	Corrective Action
Blown Line Fuse	Replace fuse. If it blows again, check the following: 1. Solder bridge or wire connection shorted. 2. Q45 and/or Q46 shorted in output amplifier. 3. One of the 7 transistors mounted on the rear panel is shorted to itself or to another transistor through the chassis. 4. Follow Table 4-2 to locate the short in a particular supply. 5. By-pass capacitors for power supply are shorted. 6. Relay in −24 V supply is shorted.
+15 V Power Supply Malfunctions	1. Voltage low: a. Transformer output low. b. Extra current loading. Check for overheated and defective component in the circuit. c. Q2 or Q3 is shorted. d. Q1 is open. e. CR2 is shorted. f. IC1 is defective. 2. Voltage high: a. Power transistor TIP29 or Q1 is shorted. b. Q3 is open. c. IC1 is defective. 3. High frequency oscillation (MHz): a. C4 or C5 at IC1 is defective. b. One of the semiconductors in another part of the circuit is oscillating. Locate by using hand to touch the most sensitive area of the circuit boards. 4. Large 60 cycle noise: a. Dirty contact. Unplug the power board and clean the contact. b. Defective filter capacitor, C1 or C9.
Other Power Supply Malfunctions	1. Follow Table 4-2 to locate the problem to a particular power supply. 2. Use similar procedure for trouble-shooting as in the +15 V power supply malfunctions.
No Output Signals	1. If no ∿ signal is present at output of ∿ AMPL, follow Table 4-3 for trouble-shooting. 2. If no signal is present at pin 4 of IC2 in the X-Y multiplier on main board, follow Table 4-7 to check out relay logic. 3. If no signal is present at both emitters of Q31 and Q32 with the ∿ function selected, follow Table 4-12 to check out the X-Y multiplier. 4. If signal is seen at emitter of Q31 and Q32, follow Table 4-5 to check out the output amplifier.
No ∿ , ⊓ or SYNC Output	Follow Table 4-12 to check out the corresponding circuit.
⊓ Rise/Fall Time Abnormally Slow	1. Malfunctioning ⊓ amplifier. 2. One of the capacitors in the output amplifier is open. 3. C75 and C77 (output amplifier) are not calibrated. 4. C50, C53 or C52 in X-Y multiplier is open.

Quick Trouble-Shooting Guide (continued)

Symptom	Corrective Action
Frequency Accuracy Out of Specification	1. Check frequency calibration. 2. Check for defective C10, C16 to C23, CR18 and/or CR20 on main board, if problem is in X10K to X1 MHz ranges. 3. Check capacitance multiplier, if problem appears in X0.001 to X1 ranges only, using Table 4-6. 4. Check digit switch, D/A converter of frequency section, if problem appears to be in frequency setting, using Table 4-9. 5. Check VCG and D/A amplifier for frequency linearity problem in all ranges, using Table 4-4. 6. Follow Table 4-10 for frequency ranging problem.
High Frequency Output Has Abnormal Ringing	1. C69 or output amplifier is open. 2. Defective capacitor in output amplifier.
High Sine Distortion at Low Frequency	1. ∿ amplitude and time symmetry calibration is off. 2. Defective sine converter. 3. Sine converter or X-Y multiplier calibration is off. 4. Dirty contact on power supply board.
High Sine Distortion at High Frequency	1. ⊓ also looks bad, if problem is in the output amplifier. 2. Defective capacitors C10 and C16 to C23 in ∿ amplifier. 3. Defective C29 to C36 in sine amplifier. 4. Defective sine converter.
Unsymmetrical ∿	Follow Table 4-4 to check out the VCG circuit.
Amplitude Accuracy Out of Specification	1. Check calibration. 2. Check for defective C25, C31 and C67 for frequency linearity problem over 1 kHz. 3. Check digit switch and D/A converter for amplitude setting problem, using Table 4-9. 4. Follow Table 4-8 for amplitude ranging problem. 5. Check X-Y multiplier, using Table 4-12.
DC Offset Accuracy Out of Specification	1. Check calibration. 2. Check digit switch and D/A converter for offset setting problem, using Table 4-9. 3. Check for zero offset of X-Y multiplier and output amplifier.
TRIG and GATED Mode Inoperative	1. Check trigger and gated control switches. 2. Check for correct signals in the trigger circuit, using Table 4-11.

4.5.2 Trouble-Shooting Guide Tables

4.5.2.1 POWER SUPPLIES

Use Table 4-2 to localize the problem to a particular power supply and associated loading circuitry. In some cases, it is necessary to turn on the power of the unit no more than one or two seconds at a time to prevent it from blowing fuses and further damage circuit components.

NOTE

Be sure to use the correct ground in the following voltage checks.

Table 4-2. POWER SUPPLIES

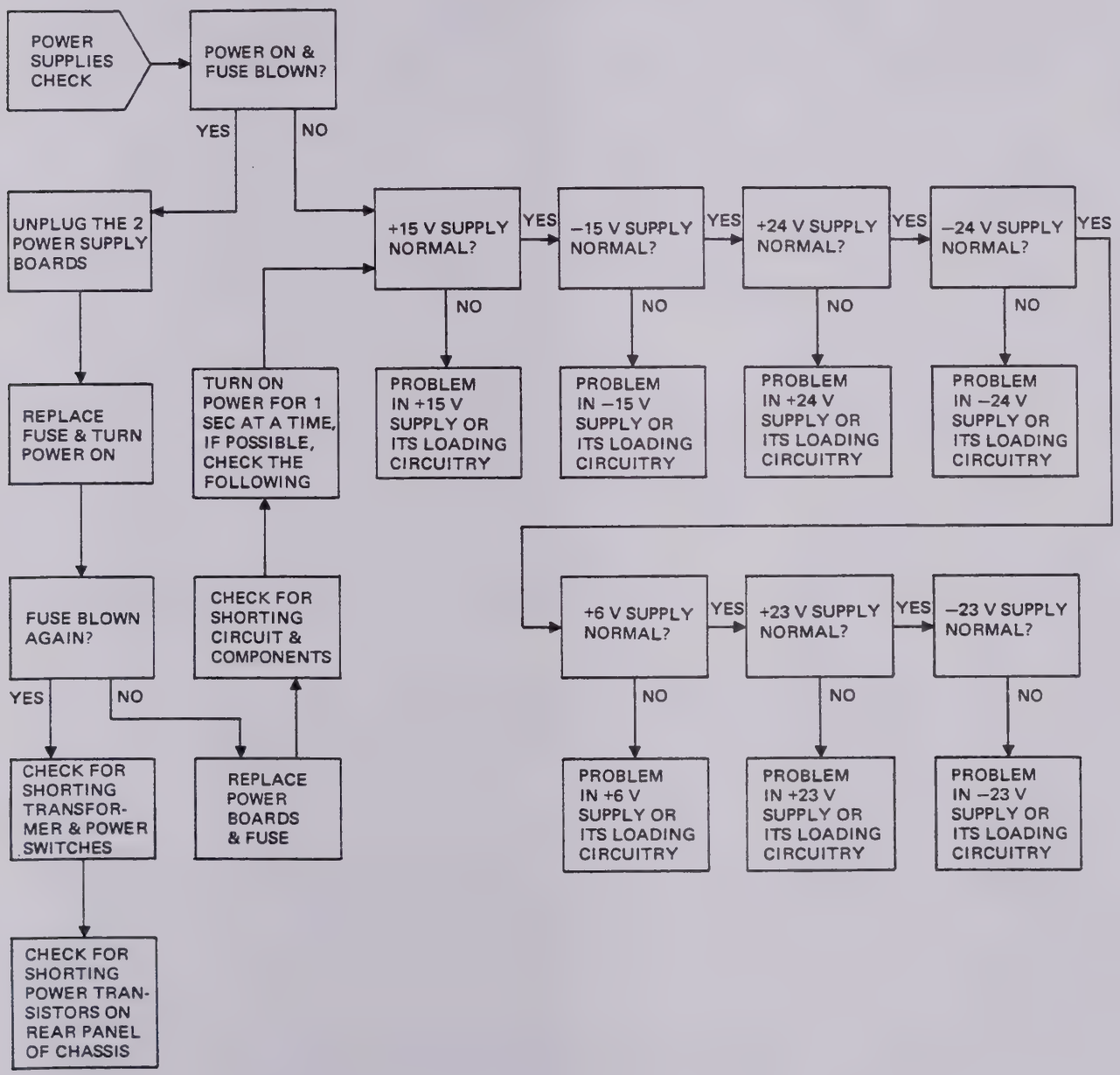

POWER SUPPLIES CHECK
POWER ON & FUSE BLOWN?
YES
NO
UNPLUG THE 2 POWER SUPPLY BOARDS
REPLACE FUSE & TURN POWER ON
FUSE BLOWN AGAIN?
YES
NO
CHECK FOR SHORTING TRANSFORMER & POWER SWITCHES
CHECK FOR SHORTING POWER TRANSISTORS ON REAR PANEL OF CHASSIS
REPLACE POWER BOARDS & FUSE
TURN ON POWER FOR 1 SEC AT A TIME, IF POSSIBLE, CHECK THE FOLLOWING
CHECK FOR SHORTING CIRCUIT & COMPONENTS
+15 V SUPPLY NORMAL?
YES
NO
PROBLEM IN +15 V SUPPLY OR ITS LOADING CIRCUITRY
−15 V SUPPLY NORMAL?
YES
NO
PROBLEM IN −15 V SUPPLY OR ITS LOADING CIRCUITRY
+24 V SUPPLY NORMAL?
YES
NO
PROBLEM IN +24 V SUPPLY OR ITS LOADING CIRCUITRY
−24 V SUPPLY NORMAL?
YES
NO
PROBLEM IN −24 V SUPPLY OR ITS LOADING CIRCUITRY
+6 V SUPPLY NORMAL?
YES
NO
PROBLEM IN +6 V SUPPLY OR ITS LOADING CIRCUITRY
+23 V SUPPLY NORMAL?
YES
NO
PROBLEM IN +23 V SUPPLY OR ITS LOADING CIRCUITRY
−23 V SUPPLY NORMAL?
NO
PROBLEM IN −23 V SUPPLY OR ITS LOADING CIRCUITRY

Table 4-3. TRIANGLE AMPLIFIER, COMPARATOR, AND HYSTERESIS SWITCH

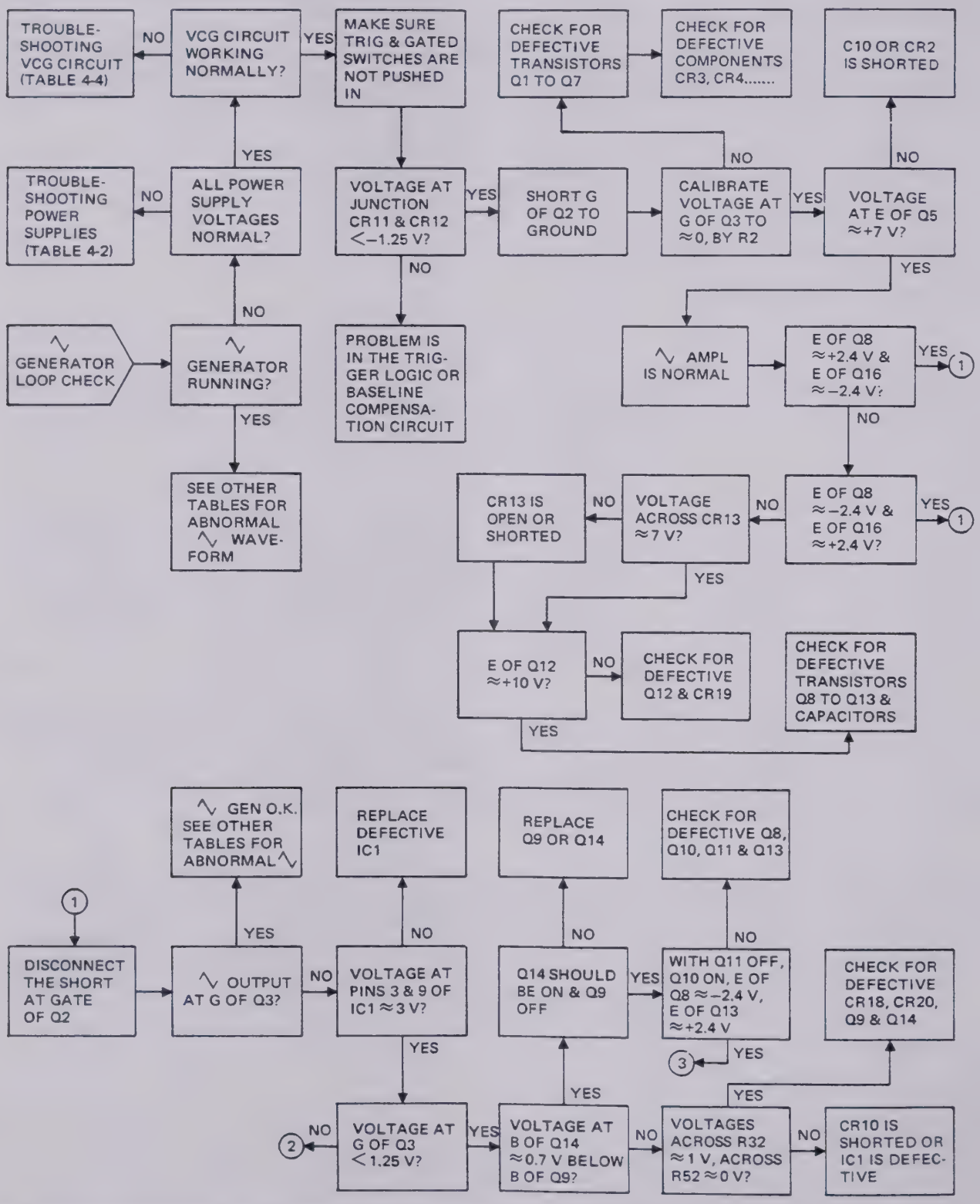


Table 4-3. TRIANGLE AMPLIFIER, COMPARATOR, AND HYSTERESIS SWITCH (Continued)

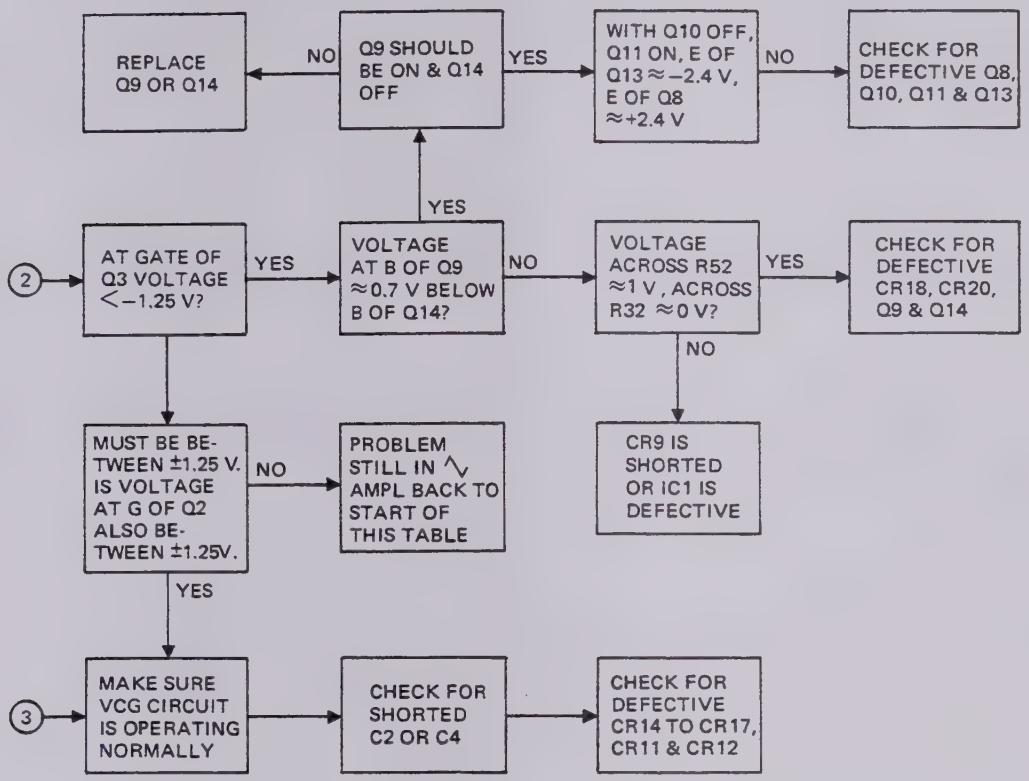

REPLACE Q9 OR Q14
NO
Q9 SHOULD BE ON & Q14 OFF
YES
WITH Q10 OFF, Q11 ON, E OF Q13 ≈ −2.4 V, E OF Q8 ≈ +2.4 V
NO
CHECK FOR DEFECTIVE Q8, Q10, Q11 & Q13
YES
2
AT GATE OF Q3 VOLTAGE < −1.25 V?
YES
VOLTAGE AT B OF Q9 ≈ 0.7 V BELOW B OF Q14?
NO
VOLTAGE ACROSS R52 ≈ 1 V, ACROSS R32 ≈ 0 V?
YES
CHECK FOR DEFECTIVE CR18, CR20, Q9 & Q14
NO
MUST BE BETWEEN ±1.25 V. IS VOLTAGE AT G OF Q2 ALSO BETWEEN ±1.25V.
NO
PROBLEM STILL IN ∿ AMPL BACK TO START OF THIS TABLE
CR9 IS SHORTED OR IC1 IS DEFECTIVE
YES
3
MAKE SURE VCG CIRCUIT IS OPERATING NORMALLY
CHECK FOR SHORTED C2 OR C4
CHECK FOR DEFECTIVE CR14 TO CR17, CR11 & CR12

Table 4-4. VCG AND CURRENT SOURCE

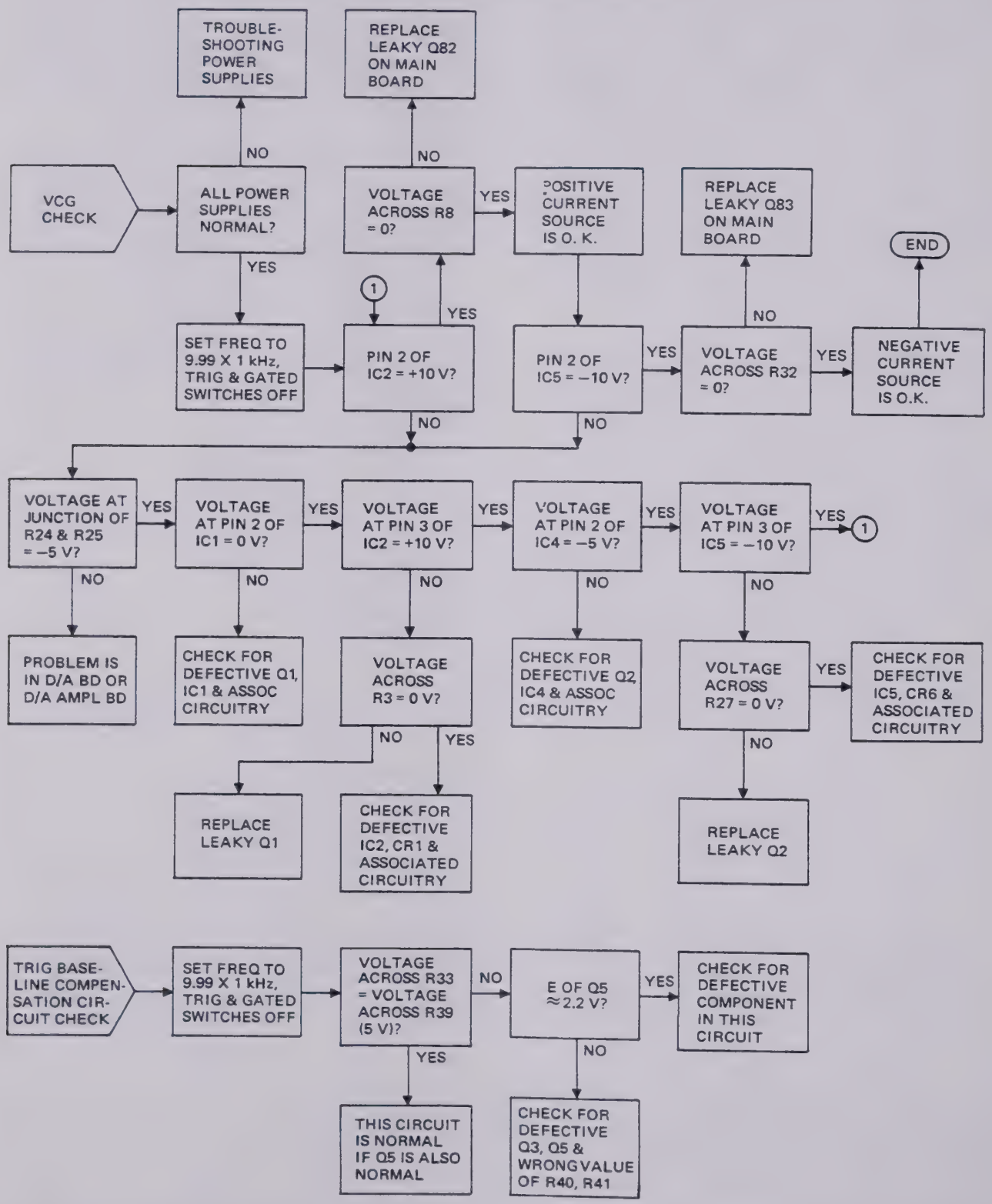

VCG CHECK
ALL POWER SUPPLIES NORMAL?
NO
TROUBLE-SHOOTING POWER SUPPLIES
YES
SET FREQ TO 9.99 X 1 kHz, TRIG & GATED SWITCHES OFF
PIN 2 OF IC2 = +10 V?
1
YES
NO
VOLTAGE ACROSS R8 = 0?
NO
REPLACE LEAKY Q82 ON MAIN BOARD
YES
POSITIVE CURRENT SOURCE IS O. K.
PIN 2 OF IC5 = −10 V?
YES
NO
VOLTAGE ACROSS R32 = 0?
NO
REPLACE LEAKY Q83 ON MAIN BOARD
YES
NEGATIVE CURRENT SOURCE IS O.K.
END
VOLTAGE AT JUNCTION OF R24 & R25 = −5 V?
YES
NO
PROBLEM IS IN D/A BD OR D/A AMPL BD
VOLTAGE AT PIN 2 OF IC1 = 0 V?
YES
NO
CHECK FOR DEFECTIVE Q1, IC1 & ASSOC CIRCUITRY
VOLTAGE AT PIN 3 OF IC2 = +10 V?
YES
NO
VOLTAGE ACROSS R3 = 0 V?
NO
YES
REPLACE LEAKY Q1
CHECK FOR DEFECTIVE IC2, CR1 & ASSOCIATED CIRCUITRY
VOLTAGE AT PIN 2 OF IC4 = −5 V?
YES
NO
CHECK FOR DEFECTIVE Q2, IC4 & ASSOC CIRCUITRY
VOLTAGE AT PIN 3 OF IC5 = −10 V?
YES
1
NO
VOLTAGE ACROSS R27 = 0 V?
YES
NO
CHECK FOR DEFECTIVE IC5, CR6 & ASSOCIATED CIRCUITRY
REPLACE LEAKY Q2
TRIG BASE-LINE COMPEN-SATION CIR-CUIT CHECK
SET FREQ TO 9.99 X 1 kHz, TRIG & GATED SWITCHES OFF
VOLTAGE ACROSS R33 = VOLTAGE ACROSS R39 (5 V)?
NO
YES
THIS CIRCUIT IS NORMAL IF Q5 IS ALSO NORMAL
E OF Q5 ≈2.2 V?
YES
NO
CHECK FOR DEFECTIVE COMPONENT IN THIS CIRCUIT
CHECK FOR DEFECTIVE Q3, Q5 & WRONG VALUE OF R40, R41

Table 4-5. OUTPUT AMPLIFIER

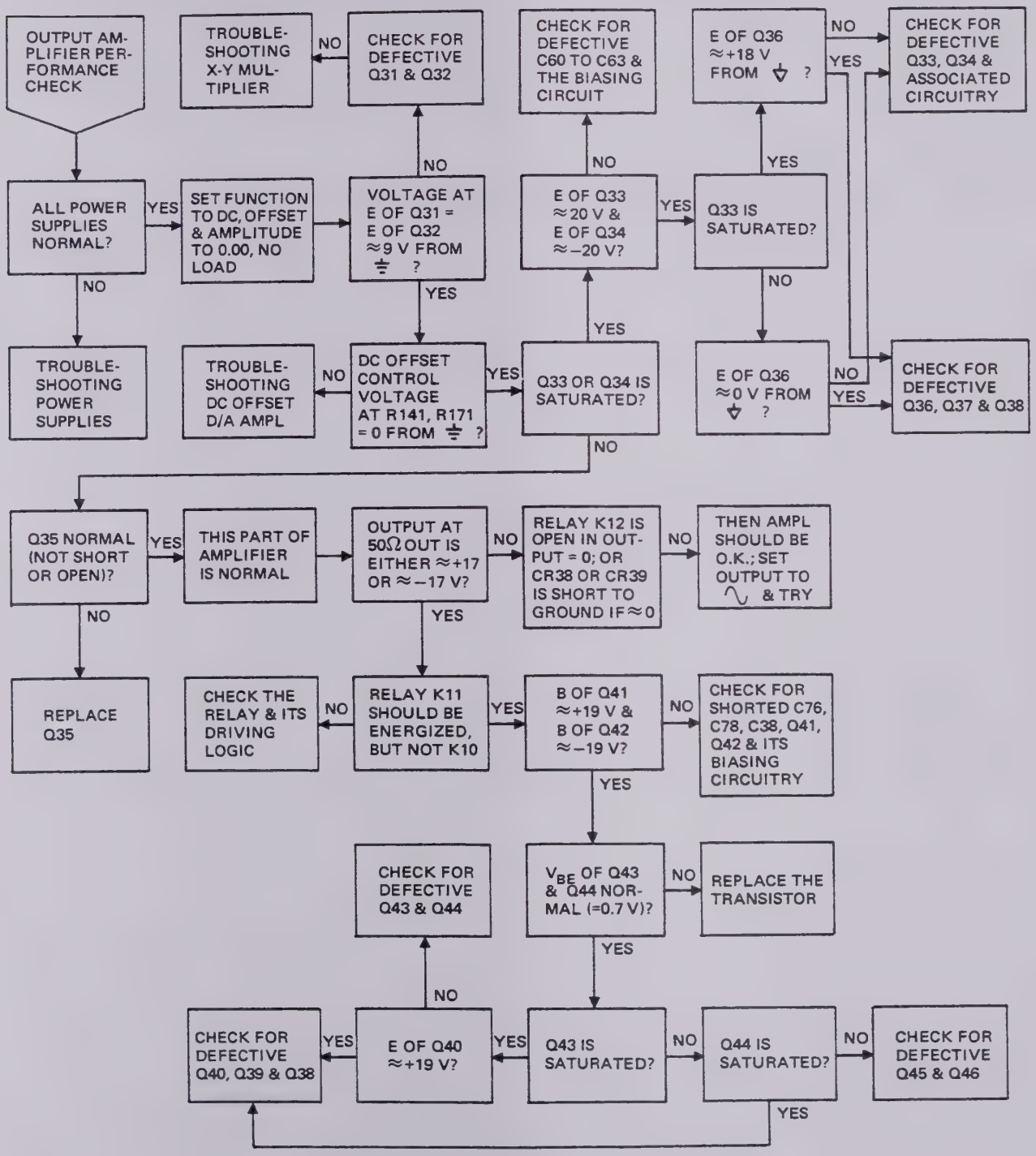

OUTPUT AMPLIFIER PERFORMANCE CHECK
ALL POWER SUPPLIES NORMAL?
YES
NO
TROUBLE-SHOOTING POWER SUPPLIES
SET FUNCTION TO DC, OFFSET & AMPLITUDE TO 0.00, NO LOAD
VOLTAGE AT E OF Q31 = E OF Q32 ≈9 V FROM ⏚ ?
NO
YES
TROUBLE-SHOOTING X-Y MULTIPLIER
CHECK FOR DEFECTIVE Q31 & Q32
TROUBLE-SHOOTING DC OFFSET D/A AMPL
DC OFFSET CONTROL VOLTAGE AT R141, R171 = 0 FROM ⏚ ?
CHECK FOR DEFECTIVE C60 TO C63 & THE BIASING CIRCUIT
E OF Q33 ≈20 V & E OF Q34 ≈−20 V?
Q33 OR Q34 IS SATURATED?
E OF Q36 ≈+18 V FROM ⏚ ?
Q33 IS SATURATED?
E OF Q36 ≈0 V FROM ⏚ ?
CHECK FOR DEFECTIVE Q33, Q34 & ASSOCIATED CIRCUITRY
CHECK FOR DEFECTIVE Q36, Q37 & Q38
Q35 NORMAL (NOT SHORT OR OPEN)?
REPLACE Q35
THIS PART OF AMPLIFIER IS NORMAL
OUTPUT AT 50Ω OUT IS EITHER ≈+17 OR ≈−17 V?
RELAY K12 IS OPEN IN OUTPUT = 0; OR CR38 OR CR39 IS SHORT TO GROUND IF ≈0
THEN AMPL SHOULD BE O.K.; SET OUTPUT TO ∿ & TRY
CHECK THE RELAY & ITS DRIVING LOGIC
RELAY K11 SHOULD BE ENERGIZED, BUT NOT K10
B OF Q41 ≈+19 V & B OF Q42 ≈−19 V?
CHECK FOR SHORTED C76, C78, C38, Q41, Q42 & ITS BIASING CIRCUITRY
CHECK FOR DEFECTIVE Q43 & Q44
V_{BE} OF Q43 & Q44 NORMAL (=0.7 V)?
REPLACE THE TRANSISTOR
CHECK FOR DEFECTIVE Q40, Q39 & Q38
E OF Q40 ≈+19 V?
Q43 IS SATURATED?
Q44 IS SATURATED?
CHECK FOR DEFECTIVE Q45 & Q46

Table 4-6. CAPACITANCE MULTIPLIER

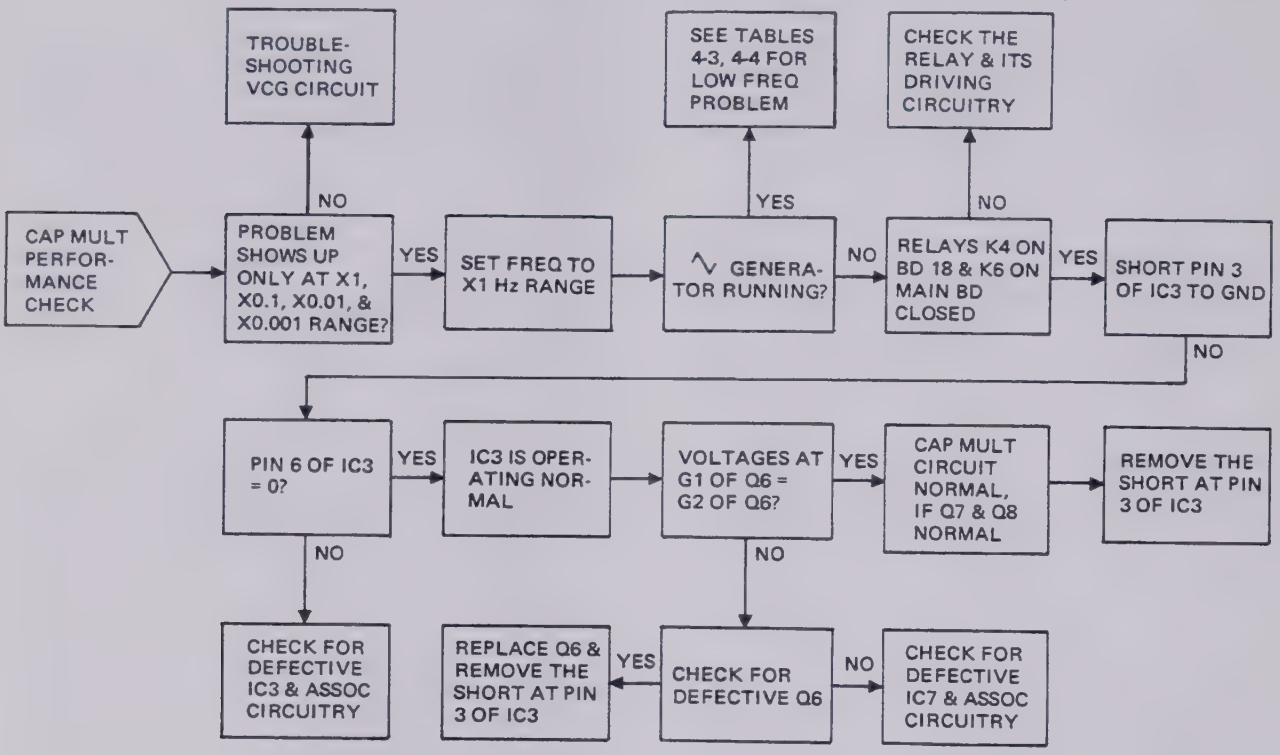

CAP MULT PERFOR-MANCE CHECK
PROBLEM SHOWS UP ONLY AT X1, X0.1, X0.01, & X0.001 RANGE?
NO
TROUBLE-SHOOTING VCG CIRCUIT
YES
SET FREQ TO X1 Hz RANGE
∿ GENERA-TOR RUNNING?
YES
SEE TABLES 4-3, 4-4 FOR LOW FREQ PROBLEM
NO
RELAYS K4 ON BD 18 & K6 ON MAIN BD CLOSED
NO
CHECK THE RELAY & ITS DRIVING CIRCUITRY
YES
SHORT PIN 3 OF IC3 TO GND
NO
PIN 6 OF IC3 = 0?
YES
IC3 IS OPER-ATING NOR-MAL
VOLTAGES AT G1 OF Q6 = G2 OF Q6?
YES
CAP MULT CIRCUIT NORMAL, IF Q7 & Q8 NORMAL
REMOVE THE SHORT AT PIN 3 OF IC3
NO
CHECK FOR DEFECTIVE IC3 & ASSOC CIRCUITRY
REPLACE Q6 & REMOVE THE SHORT AT PIN 3 OF IC3
YES
CHECK FOR DEFECTIVE Q6
NO
CHECK FOR DEFECTIVE IC7 & ASSOC CIRCUITRY
NO

Table 4-7. FUNCTION LOGIC

COMPONENTS / FUNCTION	Q58	Q59	Q60	Q61	Q62	Q63	Q64	K7	K8	K9
∿	X		X							
∿	X			X	X			X		
⊓		X		X		X			X	X
DC (Also see Table 4-8)		X	X				X			X

NOTES: 1. *For standard logic only. For inverse logic, interchange Q58 with Q59 and Q60 with Q61.*

2. *For TRIG and GATED logic, see Timing Diagram, Table 4-11.*

3. *The transistor or relay with "X" is in an "ON" state.*

4.5.2.2 AMPLITUDE RANGING CONTROL LOGIC

Table 4-8 is provided as a hint for trouble-shooting amplitude ranging control logic.

1. At X0.1 range, only Q48,Q49,Q51,Q56 and K13 are "ON" and all other transistors and relays should be "OFF".
2. Relay K12 should never be "ON" when K13, K14 or K15 is "ON".

Table 4-8. AMPLITUDE RANGING CONTROL LOGIC

COMPONENTS / AMPL RANGE	ALL COMPONENTS ARE ON MAIN CIRCUIT BOARD										
	STANDARD LOGIC ONLY, FOR INVERSE LOGIC, INTERCHANGE Q47 WITH Q48 AND Q49 WITH Q50				RELAY OR LOGIC DRIVER (ON)	(K1, D/A AMPL BOARD)					
	Q47	Q48	Q49	Q50		K10	K11	K12	K13	K14	K15
X1		X		X	Q54 Q55		X	X			
X0.1		X	X		Q51 Q56				X		
X0.01	X			X	Q52 Q56					X	
X0.001	X		X		Q53 Q56						X
DC output (Also see Table 4-7	Not Applicable		Not Applicable		Q57 Q55	X	X	X			

NOTE: The transistor or relay with "X" is in an "ON" state.

4.5.2.3 D/A CONVERTER

The D/A converter can easily be checked out by comparing the voltage level at the cathode of each switching diode according to Table 4-9. If the voltage level is not in agreement with the table, check for correct voltage at the connector and the associated circuitry.

Pin No. 1 at the connector is the summing node of the D/A amplifier and should be 0 Vdc. If not, the problem is in the D/A amplifier.

Table 4-9. D/A CONVERTER

COMPONENTS / FREQ AMPL OR OFFSET SETTINGS	PIN NUMBER AT CONNECTOR D/A CONVERTER BOARD												DIODE (CR) NUMBER (VOLTAGE AT CATHODE)											
	3	4	5	6	7	8	9	11	12	13	14	15	40	37	34	30	27	24	21	17	14	11	8	4
0.00	0	0	0	0	0	0	0	0	0	0	0	0	L	L	L	L	L	L	L	L	L	L	L	L
1.11	1	0	0	0	1	0	0	0	1	0	0	0	H	L	L	L	H	L	L	L	H	L	L	L
2.22	0	1	0	0	0	1	0	0	0	1	0	0	L	H	L	L	L	H	L	L	L	H	L	L
3.33	1	1	0	0	1	1	0	0	1	1	0	0	H	H	L	L	H	H	L	L	H	H	L	L
4.44	0	0	1	0	0	0	1	0	0	0	1	0	L	L	H	L	L	L	H	L	L	L	H	L
5.55	1	0	1	0	1	0	1	0	1	0	1	0	H	L	H	L	H	L	H	L	H	L	H	L
6.66	0	1	1	0	0	1	1	0	0	1	1	0	L	H	H	L	L	H	H	L	L	H	H	L
7.77	1	1	1	0	1	1	1	0	1	1	1	0	H	H	H	L	H	H	H	L	H	H	H	L
8.88	0	0	0	1	0	0	0	1	0	0	0	1	L	L	H	H	L	L	H	H	L	L	H	H
9.99	1	0	0	1	1	0	0	1	1	0	0	1	H	L	H	H	H	L	H	H	H	L	H	H

NOTE: H = +6 V.
L = 0 V.
1 is > 2.4 V for standard logic, < 1 V for inverting logic.
0 is < 1 V for standard logic, > 2.4 V for inverting logic.

4.5.2.4 FREQUENCY RANGING LOGIC

Table 4-10 is provided as a hint for trouble-shooting frequency ranging and calibration problems. A few typical examples are listed below to clarify the use of this table.

1. Defective Q16, C12, K3, R39 or K6 will cause abnormal frequency output at X1K range. Shorted C3 will have 0 Vdc output. Inoperative K4 will have frequency output as at X1 MHz range, etc.
2. Frequency stays the same at all ranges from X0.001 to X10 Hz, if relay K6 is not energized or is open.
3. Frequency out of specification at X10K, X0.1M and X1M ranges indicates that R40 is not properly calibrated.
4. Each pair of transistors, Q1 and Q2, Q3 and Q4, Q5 and Q6, and Q7 and Q8, should never be "ON" or "OFF" simultaneously. If this occurs, all frequency ranging is wrong, or there is no ranging control at all.

Table 4-10. FREQUENCY RANGING LOGIC

COMPONENTS / FREQ RANGING	TRANSISTORS ON FREQ RANGING BOARD (See Note 1)				MAIN BD							VCG BD			D/A AMPL BD			
	Q1 Q2	Q3 Q4	Q5 Q6	Q7 Q8	RELAY OR LOGIC DRIVER (ON)	C6 C7 C8	C11	C12	C13	C14 CAP C15 MULT		R20 R22 R21 R23	R16 R17		R37	R38	R39	R40
						K1	K2	K3	K4	K5	K6	K2	K3	K4	K4	K5	K6	K7
X0.001	X	X	X	X	Q9, Q21 Q13, Q14					X	X				X			
X0.01	X	X	X	X	Q10, Q21 Q13, Q14					X	X	X			X			
X0.1	X	X	X	X	Q11, Q21 Q13, Q14					X	X		X		X			
X1	X	X	X	X	Q12, Q21 Q13, Q14					X	X			X	X			
X10	X	X	X	X	Q14					X					X			
X100	X	X	X	X	Q15				X							X		
X1K	X	X	X	X	Q16			X									X	
X10K	X	X	X	X	Q17, Q18 Q20		X											X
X0.1M	X	X	X	X	Q18, Q19 Q20	X												X
X1M	X	X	X	X	Q18, Q20													X

NOTES: 1. For standard control logic only (for inverse logic, interchange each pair of transistors).
2. The transistor or relay with "X" is in its "ON" state.

4.5.2.5 TRIGGER AND GATED LOGIC TIMING

For trouble-shooting the trigger, set the generator at GATED mode. Refer to Table 4-11. Draw a vertical line on the timing diagram along t_1 or t_2, depending on whether the TRIG IN signal is low or high, and check for correct voltage levels according to the timing diagram.

After the GATED mode has been checked out and is working normally, the TRIG mode can be checked in the same way but concentrated in the Q78, Q77 area.

Table 4-11. TRIGGER AND GATED LOGIC TIMING DIAGRAM

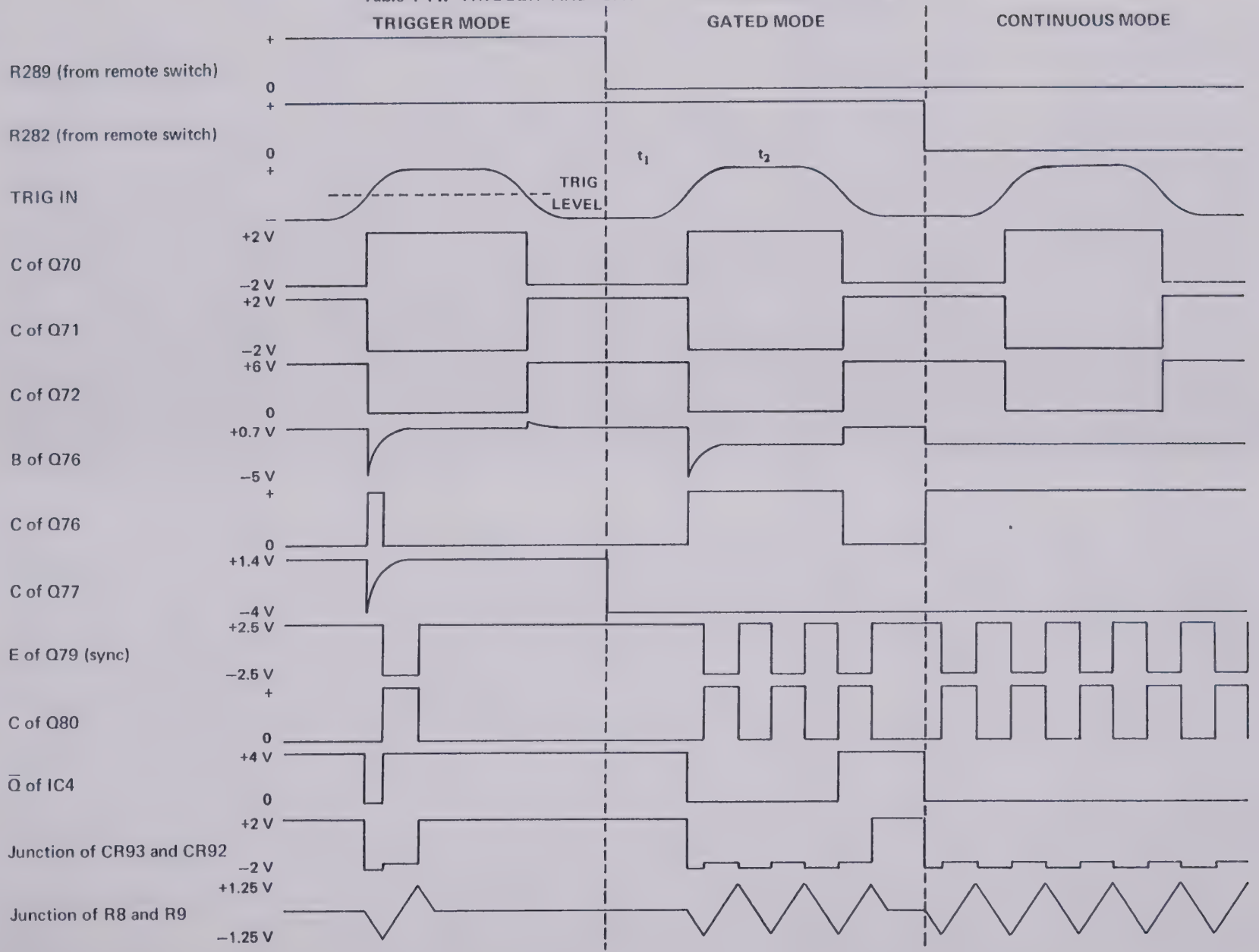


Table 4-12. KEY SIGNAL AND VOLTAGE

∿ AMPLIFIER, COMPARATOR AND HYSTERESIS SWITCH

Test Point	Typical Voltage
G of Q2	2.5 V p-p ∿, 0 Vdc offset
G of Q3	2.5 V p-p ∿, 0 Vdc offset
E of Q5	2.5 V p-p ∿, ≈ +7 Vdc offset
Pins 1 and 4 of IC1	See Table 4-13
Pins 2 and 8	−3 V
Pins 3 and 9	−3.7 V
E of Q14	+6.8 Vdc
B of Q14 and Q9	See Table 4-13
E of Q8 and Q13	See Table 4-13
E of Q12	+10 V
R42 and R45 junction	−3 V
S of Q82	+10 V to +15 V, dependent on frequency setting
S of Q83	−10 V to −15 V, dependent on frequency setting

∿ CONVERTER AND AMPLIFIER

Test Point	Typical Voltage
Pin 2 of A1	See Table 4-13
Pin 4 of A1	+14 V
Pin 1 of A1	−14 V
Pin 5 of A1	250 mV p-p ∿, 0 Vdc offset
R75 and R76 junction	2.5 V p-p ∿, 0 Vdc offset
B of Q17 and Q18	+8 V

SYNC AND SQUARE AMPLIFIER

Test Point	Typical Voltage
R84 and R56 junction	±2.4 V ⊓
CR27 cathode	±1.25 V ⊓
R95 and R96 junction	±1.25 V ⊓

AUX AMPLIFIER

Test Point	Typical Voltage
E of Q26	0 to +6 V ⊓
E of Q27	+3.5 V
C of Q29	0 to +6 V ⊓, < 5 ns RF time

X-Y MULTIPLIER

Test Point	Typical Voltage
R111	Selected signal (∿, ∿, ⊓ or DC)
R110	VCA input, voltage dependent on amplitude setting
Pins 8 and 12 of IC2	0 Vdc
Pin 5 of IC2	Same signal as at pin 4, but −1.4 V offset
Pins 6 and 11 of IC2	−1.4 V
Pin 10 of IC2	−1.4 V below pin 9
Pins 3 and 13	−13.5 V
Pin 1 of IC2	+5 V
E of Q32	Selected signal output, +9 Vdc offset, amplitude dependent on setting
E of Q31	Inverted output of Q32

OUTPUT AMPLIFIER

Test Point	Typical Voltage
Voltage between ⏚ and ▽	−1 to +1 V (when floating)
E of Q33	+19 Vdc
E of Q34	−19 Vdc
R157 and R158 junction	+0.7 Vdc
E of Q35	Selected waveform, 0 to 1 V p-p
E of Q36	+10 V ±5 V
B of Q41	+19 Vdc
E of Q43	+19 Vdc
B of Q42	−19 Vdc
E of Q44	−19 Vdc
R166 and R168 junction	+0.7 Vdc
E of Q37 and Q39	+19 Vdc
E of Q40	+2 V to +18 V
R192 and R193 junction	Main output, ±15 V maximum

D/A AMPLIFIER

Pins 2 and 3 of all D/A amplifiers (IC1, IC2 and IC3) are 0 Vdc. Their output voltages are dependent on front panel and remote control settings. The gain of IC2 will decrease to ½ when dc output is selected and K1 is closed.

Table 4-12. KEY SIGNAL AND VOLTAGE (Continued)

VCG AMPLIFIER AND TRIGGER BASELINE COMPENSATION

Test Point	Typical Voltage
R24 and R25 junction	0 to −5 V*
S of Q1	0 V
Pins 2 and 3 of IC2	+15 to +10 V*
S of Q2	0 to −5 V*
Pins 2 and 3 of IC5	−15 to −10 V*
V_{GS} of Q3	$V_{G1,S1} = V_{G2,S2}$
R36 and R37	Voltage across both are equal
E of Q5	+2.2 V
R36	Voltage across R39 and R29 are equal

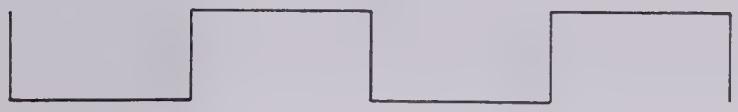
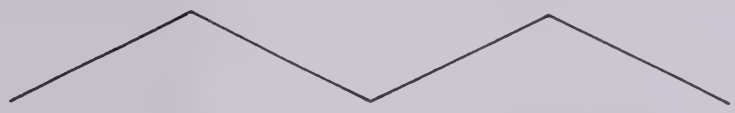
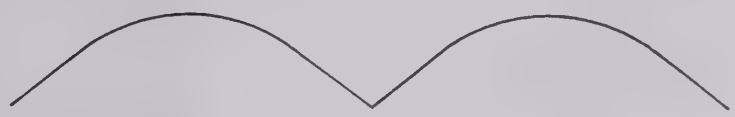
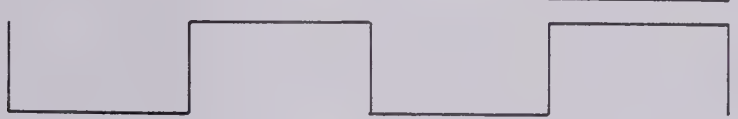
*Voltage is dependent on a frequency setting of 0.00 to 9.99.

CAPACITANCE MULTIPLIER*

Test Point	Typical Voltage
G1 and G2 of Q6	±1.25 V ∿
Pin 6 of IC7	⊓⊔, amplitude dependent on frequency setting
Pins 2 and 3 of IC3	±1.25 V ∿
Pin 6 of IC3	±7.50 V ∿

*The above information applies if the frequency range is at X1 Hz.

Table 4-13. KEY WAVEFORMS

Test Point	Waveforms
AUX OUT	
G of Q2 G of Q3	+1.25 V −1.25 V 
Pin 1 of IC1	+0.7 V −0.5 V
Pin 4 of IC1	+0.5 V −0.7 V 
B of Q14	+7 V +6.3 V
B of Q9	+7 V +6.3 V
E of Q8	+2.4 V −2.4 V
E of Q13	+2.4 V −2.4 V 
CR16 Anode	+2 V −2 V
CR17 Cathode	+2 V −2 V
P2 of A1	+0.6 V −0.6 V
P5 of A1	+0.12 V −0.12 V
R75 and R76	+1.25 V −1.25 V

SECTION 5
DIAGRAMS, ADDENDA AND PARTS LISTS

5.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

5.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit and, if applicable, the function performed.

5.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

CROSS REFERENCE FOR DRAWING NUMBERS

Drawings	Old Number	New Number	Drawings	Old Number	New Number
Chassis Schematic	154-200	0004-00-0041	D-A Converter Schematic	154-213	0103-00-0083
Chassis Assy	154-000	0002-00-0300	D-A Converter Assy	154-013	0101-00-0083
Chassis Parts List	*	1101-00-0041	D-A Converter Parts List	*	1100-00-0083
Main Board Schematic	154-215	0103-00-0085	Frequency Range Schematic	154-212	0103-00-0082
Main Board Assy	154-015	0101-00-0085	Frequency Range Assy	154-012	0101-00-0082
Main Board Parts List	*	1100-00-0085	Frequency Range Parts List	*	1100-00-0082
Patch Block Assy	154-024	1205-00-0489	D-A Amplifier Schematic	154-214	0103-00-0084
Patch Block Parts List	*	*	D-A Amplifier Assy	154-014	0101-00-0084
			D-A Amplifier Parts List	*	1100-00-0084
Mother Board Assy	154-010	0101-00-0080			
Mother Board Parts List	*	1100-00-0080	VCG Board Schematic	154-216	0103-00-0086
			VCG Board Assy	154-016	0101-00-0086
15V, 24V Power Supply Schematic	154-211	0103-00-0081	VCG Board Parts List	*	1100-00-0086
15V, 24V Power Supply Assy	154-011	0101-00-0081	Transistor Mounting Board Assy	154-017	0101-00-0087
15V, 24V Power Supply Parts List	*	1101-00-0081	Transistor Mounting Board Parts List	*	1100-00-0087
6V, 23V Power Supply Schematic	154-221	0103-00-0089			
			Rear Panel Assy	154-001	0102-00-0331
6V, 23V Power Supply Assy	154-021	0101-00-0089	Rear Panel Parts List	*	1101-00-0072
6V, 23V Power Supply Parts List	*	1100-00-0089			
			Extender Board Assy	154-018	0101-00-0088
			Extender Board Parts List	*	1100-00-0088

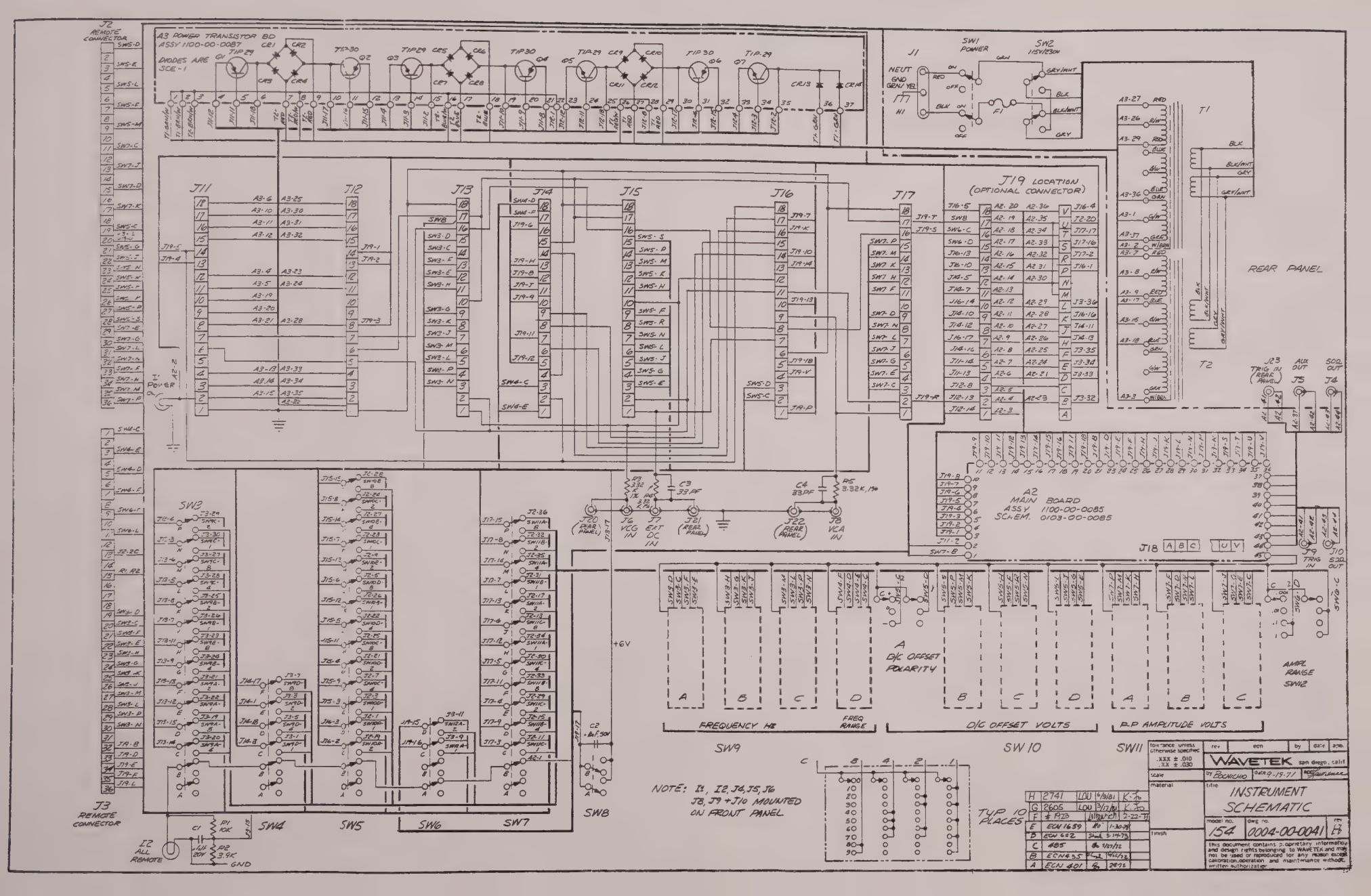
*Same as assembly number

5.4 RECOMMENDED SPARE PARTS LIST

Information is provided to maintain the instrument on a board or component level. Price and delivery information should be obtained from the Wavetek representative in your area or directly from the factory.

DESCRIPTION	MFG	PART NO.	QTY
BOARD LEVEL			
15 V, 24 V POWER SUPPLY BOARD	WAVETEK	154-011	1
FREQ RANGING BOARD	WAVETEK	154-012	1
D/A CONVERTER BOARD	WAVETEK	154-013	1
D/A AMPLIFIER BOARD	WAVETEK	154-014	1
VCG BOARD	WAVETEK	154-016	1
6 V, 23 V POWER SUPPLY BOARD	WAVETEK	154-021	1
COMPONENT LEVEL			
DIODE TUNNEL	GE	1N3716	1
DIODE	SEMTECH	SCE-1	2
DIODE	FAIRCHILD	FD777	1
DIODE	FAIRCHILD	FD6666	8
★DIODE –69	FAIRCHILD	FD6666	2
DIODE ZENER	WAVETEK	130-506	2
FUSE ½A 115 V	LITTELFUSE	313-500	1
FUSE ¼A 230 V	LITTELFUSE	313-250	
★INTEGRATED CKT –13	FAIRCHILD	μA709C	2
★INTEGRATED CKT –14	FAIRCHILD	μA709C	2
INTEGRATED CKT	RCA	CA3028A	1
INTEGRATED CKT	RCA	CA3049	1
INTEGRATED CKT	MOTOROLA	MC1595L	1
INTEGRATED CKT	MOTOROLA	MC3050P	1
LAMP	MURA	BP 28/40	2
RELAY	JENCO	RR30-1023	2
RELAY	JENCO	RR30-1024	2
SINE MODULE	WAVETEK	B142-011	1
TRANSISTORS	FAIRCHILD	2N3638	8
TRANSISTORS	FAIRCHILD	2N3642	2
TRANSISTORS	FAIRCHILD	2N3646	8
TRANSISTORS	FAIRCHILD	2N4248	2
TRANSISTORS	MOTOROLA	MPS L08	1
TRANSISTORS	MOTOROLA	2N2905A	1
★TRANSISTORS –52	MOTOROLA	2N3563	2
★TRANSISTORS –53	MOTOROLA	2N5485	2
★TRANSISTORS –54	MOTOROLA	2N5485	1
★TRANSISTORS –55	MOTOROLA	2N5462	1
★TRANSISTORS –66	MOTOROLA	2N2219A	2
TRANSISTORS	TEXAS INST	TIP 29	2
TRANSISTORS	TEXAS INST	TIP 30	2
TRANSISTORS	TECH PROD	TP 308	1

★ Denotes special selected parts and should be ordered from Wavetek.


A3 POWER TRANSISTOR BD
ASSY 1100-00-0087
DIODES ARE SCE-1
TIP29
TIP30
SW1 POWER
SW2 115V/230V
T1
T2
REAR PANEL
J19 LOCATION (OPTIONAL CONNECTOR)
A2 MAIN BOARD
ASSY 1100-00-0085
SCHEM. 0103-00-0085
J1 REMOTE CONNECTOR
J2 REMOTE CONNECTOR
J3 REMOTE CONNECTOR
J11
J12
J13
J14
J15
J16
J17
J18
J20 (REAR PANEL)
J21 (REAR PANEL)
J22 (REAR PANEL)
J23 TRIG IN (REAR PANEL)
J5 AUX OUT
J4 SQR OUT
J6 VCG IN
J7 EXT DC IN
J8 VCA IN
J9 TRIG IN
J10 SQR OUT
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
FREQUENCY HZ
FREQ RANGE
D/C OFFSET VOLTS
D/C OFFSET POLARITY
P-P AMPLITUDE VOLTS
AMPL RANGE SW12
+6V
NOTE: I1, I2, J4, J5, J6 J8, J9 +J10 MOUNTED ON FRONT PANEL
TYP 10 PLACES
I1 POWER
I2 ALL REMOTE
WAVETEK
San Diego, Calif
INSTRUMENT SCHEMATIC
model no. 154
dwg no. 0004-00-00041
rev H
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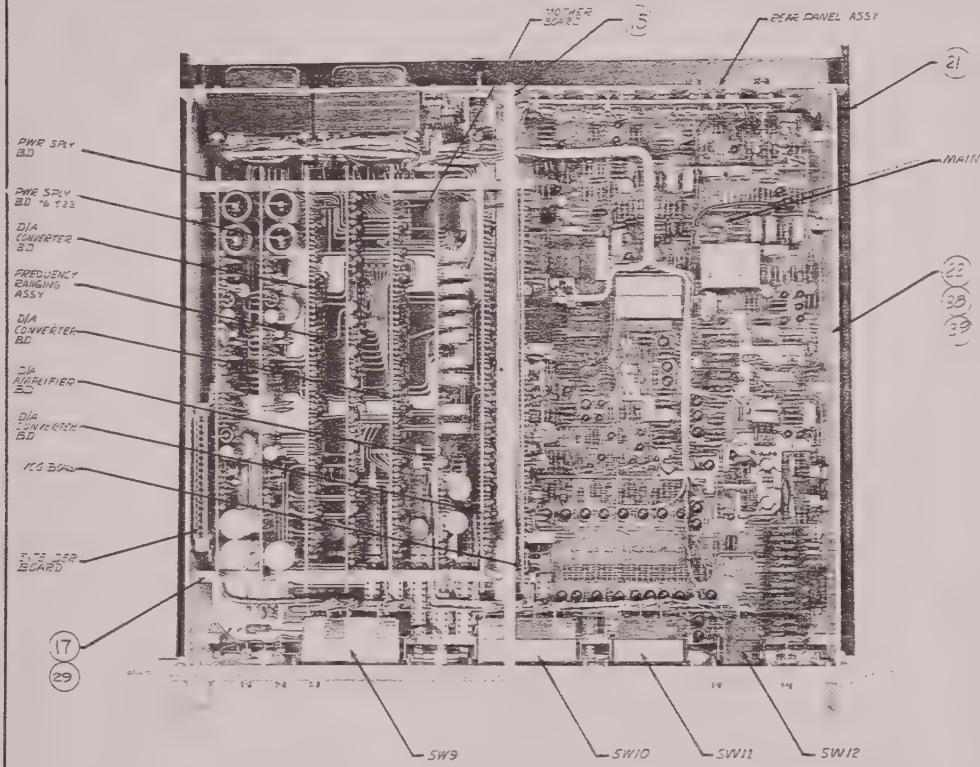
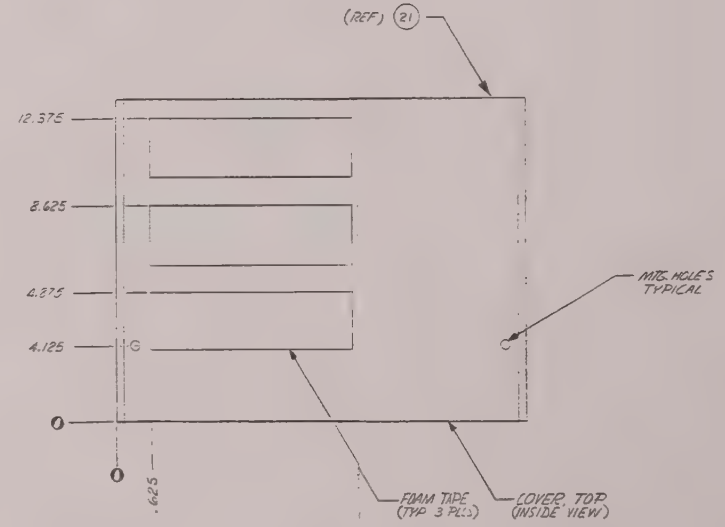
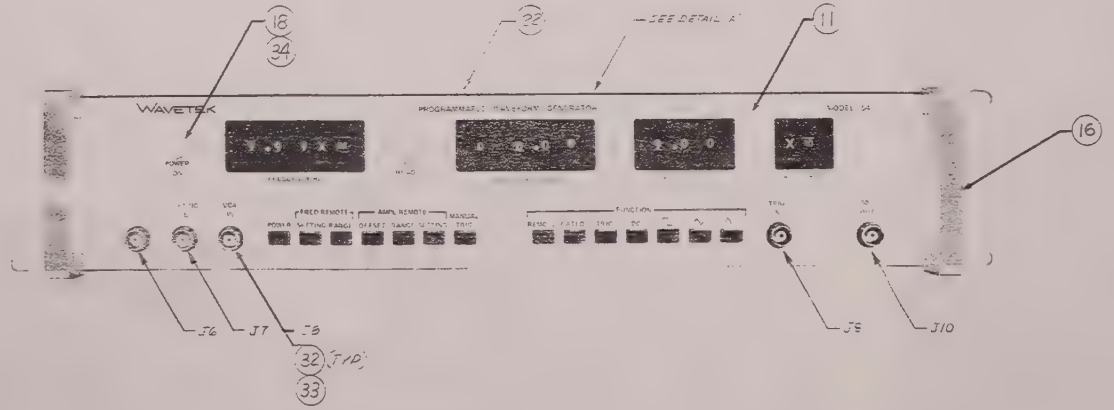




DETAIL "A"
INSTALLATION OF FOAM TAPE



H	ECN 1390	RO	2-3-77
G	ECN 730		
F	ECN 721		
E	E.N. [illegible]		
D	ECN-683		
C	ECN 455		
B	ECN 417		
A	ECN 401		

tolerance unless otherwise specified	rev	ecn	by	date	app.
.XXX ± .010 .XX ± .030	WAVETEK san diego calif				
scale N/A	by DYMCHIS	date 2-18-71	app.		
material N/A	title CHASSIS ASS'Y				
finish N/A	model no. 154	dwg no. SHT 1 OF 2 0002-00-0300			rev

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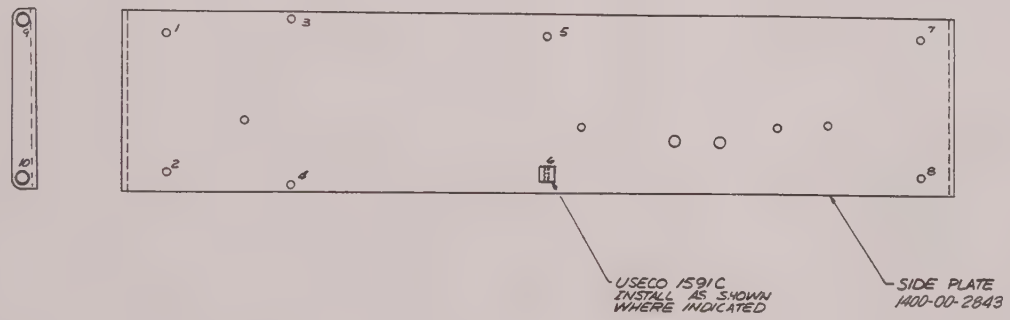

HOLE	LEFT	RIGHT
1	X	
2		X
3	X	X
4	X	X
5	X	
6		X
7	X	
8		X
9	INSTALL BOOTS FASTENERS T8100100 LEFT & RIGHT	
10		

X INDICATES INSTALL BLOCK

1 LEFT
1 RIGHT REQ'D/UNIT

SEE SHEET 1

rev	ecn	by	date	appr.
A	ECN 401	BC	12-2-72	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale FULL | by BOCHKNIO | date 11-11-71 | appr. KC

material N/A

title CHASSIS ASSEMBLY
LEFT + RIGHT SIDE PLATES

finish N/A

model no. 154 | dwg no. SHT 2 of 2 | 0002-00-0300 | rev H

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. CHASSIS	0102-00-0300	WVTK	0102-00-0300	1
22	SUB PANEL ASSY	154-004	WVTK	1201-00-0020	1
29	SPACER	144-305	WVTK	1400-00-2112	2
11	PANEL, FT	154-300	WVTK	1400-00-2810	1
23	RAIL, SIDE	154-303	WVTK	1400-00-2843	2
14	BAR, SUPT	154-304	WVTK	1400-00-2853	1
15	BAR, SUPT, TOP	154-305	WVTK	1400-00-2863	1
17	GUIDE, BD	154-310	WVTK	1400-00-2880	2
18	LENS, INDICATOR	154-311	WVTK	1400-00-2890	2
21	COVER	154-319	WVTK	1400-00-2922	2
16	HANDLE REF 3200-06-0001	154-320	WVTK	1400-00-2933	2
NONE	SHIELD, INSULATOR REF. 3200-03-0004	154-324	WVTK	1400-00-3560	1
NONE	ID LABEL SPECIAL INSTRUMENT	1400-01-0990	WVTK	1400-01-0990	1
J10 J6 J7 J8 J9	BNC CONN	KC-7946	KING	2100-01-0002	5
NONE	CONN	57-30360	AMPH	2100-02-0038	2
31	SOLDER LUG	1497	SMITH	2100-04-0012	5

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY NO 1101-00-0041 PAGE 1	REV K

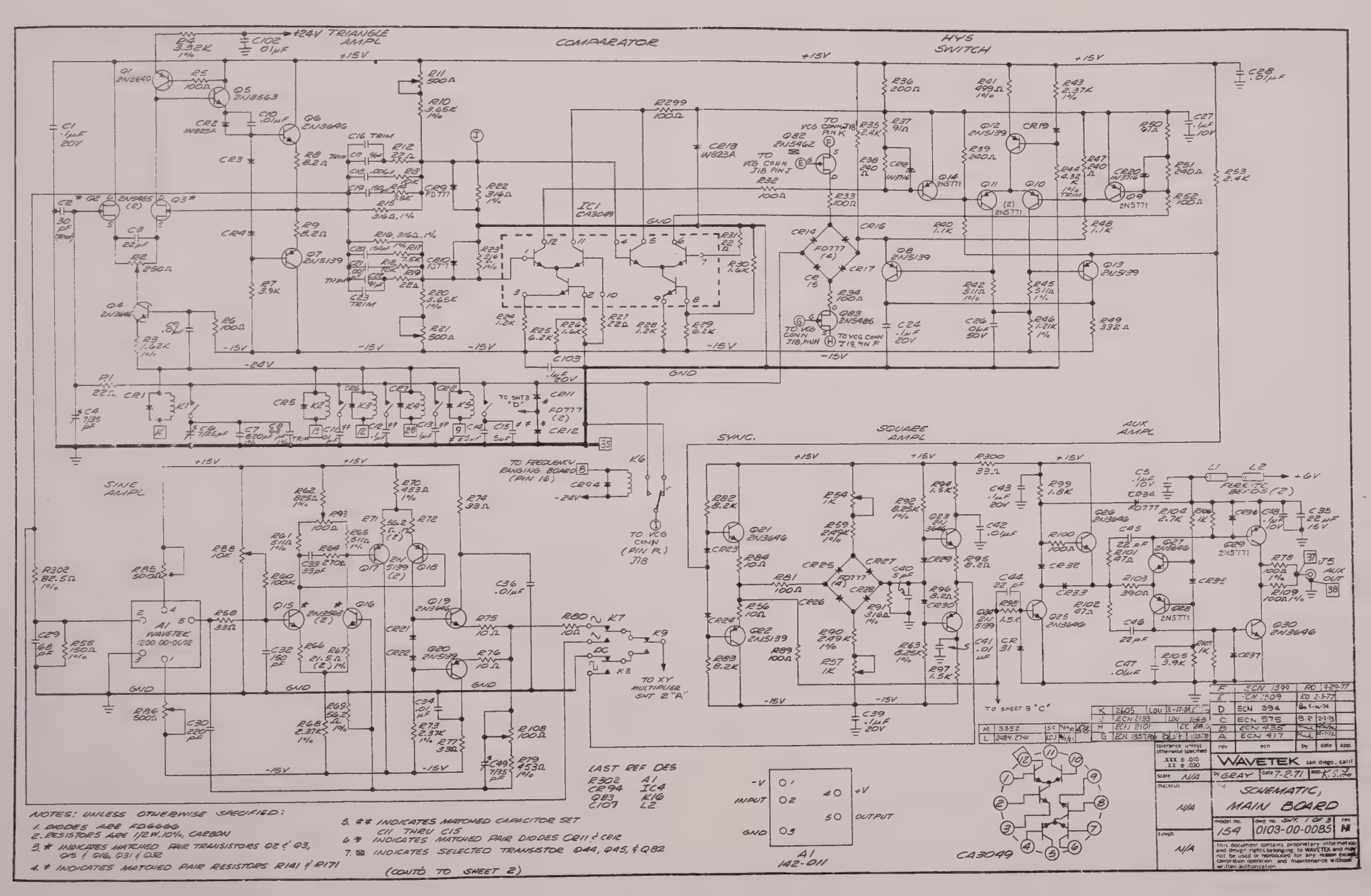
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
40	INSERT, BANC, LOC	TB1D100-632	BOOTS	2800-09-0013	4
41	FAST. CHASSIS	1591-C11	USECO	2800-09-0022	10
43	WASHER, SHOULDER	2661	SMITH	2800-27-0002	2
32	WASHER, SHOULDER	2668	SMITH	2800-27-0004	5
33	NYLON FLAT WASHER	2264-N-385	AMTOM	2800-28-0005	5
34	RETAINING RING	5305-31	TRURC	2800-30-0002	2
SW9	SWITCH ASSY DIGI	154-400	WVTK	5107-00-0001	1
SW10	SWITCH ASSY DIGI	154-401	WVTK	5107-00-0002	1
SW11	SWITCH ASSY DIGI	154-402	WVTK	5107-00-0003	1
SW12	SWITCH ASSY DIGI	154-403	WVTK	5107-00-0004	1
NONE	PWR CORD	6001-80-0005	WVTK	6001-80-0005	1

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY NO 1101-00-0041 PAGE 2	REV K

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST CHASSIS
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030		
	DO NOT SCALE DWG	MODEL NO 154	DWG NO. 1101-00-0041 REV K
	SCALE	CODE IDENT 23338	SHEET 1 OF 1

NOTE UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS
MICRONEER NO. A-2254



NOTES: UNLESS OTHERWISE SPECIFIED:

1. DIODES ARE FDG666
2. RESISTORS ARE 1/2 W, 10%, CARBON
3. * INDICATES MATCHED PAIR TRANSISTORS Q2 & Q3, Q15 & Q16, Q31 & Q32
4. # INDICATES MATCHED PAIR RESISTORS R141 & R171
5. ** INDICATES MATCHED CAPACITOR SET C11 THRU C15
6. ⊠ INDICATES MATCHED PAIR DIODES CR11 & CR12
7. ⊠ INDICATES SELECTED TRANSISTOR Q44, Q45, & Q82

(CONT'D TO SHEET 2)

rev	ecn	by	date	app
F	ECN 1599	RO	9-29-77	
E	ECN 1509	EO	2-3-77	
D	ECN 994	BS	5-14-74	
C	ECN 575	B.E	2-2-73	
B	ECN 455	[illegible]	[illegible]	
A	ECN 417	[illegible]	[illegible]	
K	2605	LOU	3-17-81	
J	ECN 2199	LOU	11-6-8	
H	ECN 2101	EC	[illegible]	
G	ECN 1857	[illegible]	[illegible]	
M	3352	SC	[illegible]	
L	2484, 2741	LOU	[illegible]	

tolerance unless otherwise specified	.XXX ± .010 .XX ± .030
scale	N/A
material	N/A
finish	N/A

WAVETEK san diego, calif

by	GRAY
date	7-2-71
app	K.S.H.

SCHEMATIC, MAIN BOARD

model no.	dwg no. SHT. 1 OF 3	rev
154	0103-00-0085	M

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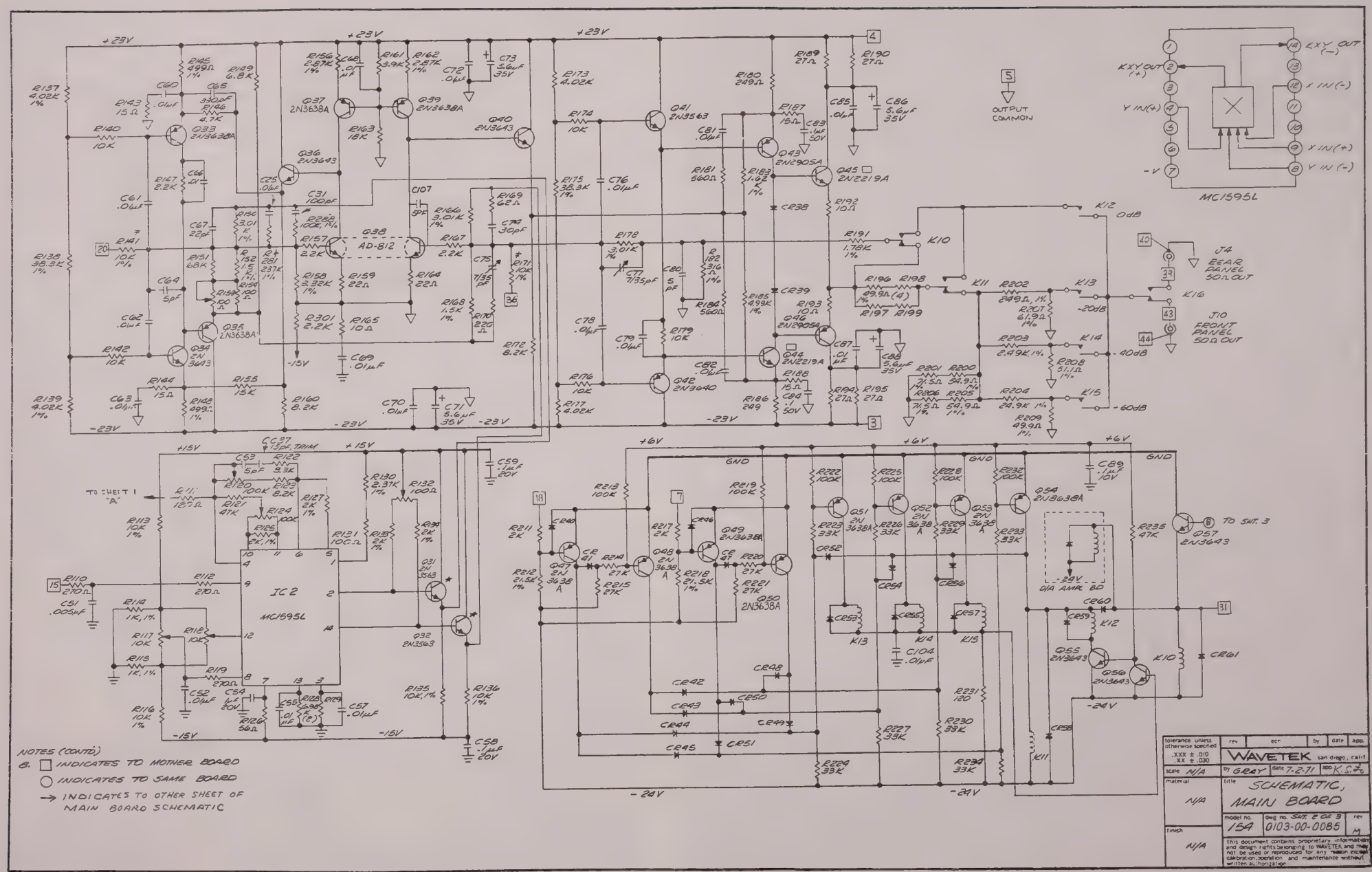
+23V
-23V
+15V
-15V
+6V
-6V
-24V
GND
OUTPUT COMMON
MC1595L
IC 2
TO SHEET 1 "A"
TO SHT. 3
J4 REAR PANEL 50Ω OUT
J10 FRONT PANEL 50Ω OUT
K10
K11
K12
K13
K14
K15
K16
0dB
-20dB
40dB
-60dB
D/A AMP. BD
NOTES (CONT'D)
B. □ INDICATES TO MOTHER BOARD
○ INDICATES TO SAME BOARD
→ INDICATES TO OTHER SHEET OF MAIN BOARD SCHEMATIC
WAVETEK
SCHEMATIC, MAIN BOARD
model no. 154
dwg no. SHT. 2 OF 3
0103-00-0085
rev M
scale N/A
material N/A
finish N/A
by GRAY
date 7-2-71
app K.S.
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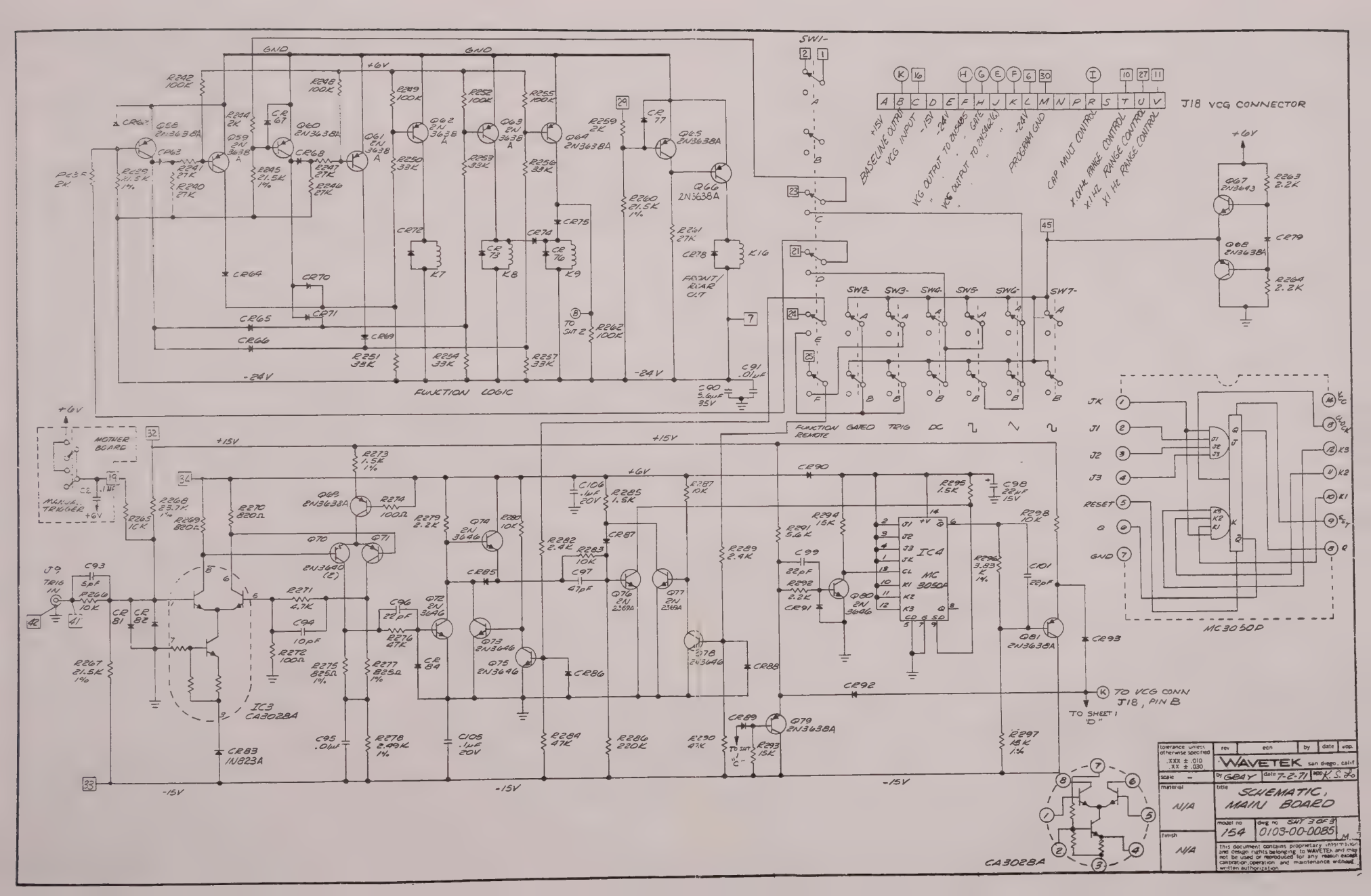
GND
+6V
-24V
-15V
+15V
SW1-
SW2-
SW3-
SW4-
SW5-
SW6-
SW7-
J18 VCG CONNECTOR
+15V BASELINE OUTPUT
VCG INPUT
-15V
-24V
VCG OUTPUT TO 2N5265
" GATE
VCG OUTPUT TO 2N5265(C)
" -24V
PROGRAM GND
CAP MULT CONTROL
X.01Hz RANGE CONTROL
X1 Hz RANGE CONTROL
X1 Hz RANGE CONTROL
FUNCTION LOGIC
FUNCTION GATED TRIG DC
FUNCTION REMOTE
MOTHER BOARD
MANUAL TRIGGER
TRIG IN
TO SHT 2
TO VCG CONN J18, PIN B
TO SHEET 1 "D"
IC3 CA3028A
IC4 MC 3050D
CA3028A
MC3050D
WAVETEK san diego, calif
SCHEMATIC, MAIN BOARD
model no 154
dwg no SHT 3 OF 3 0103-00-0085
material N/A
finish N/A
scale —
by GBAY date 7-2-71 app K.S.Lo
tolerance unless otherwise specified .XXX ± .010 .XX ± .030
rev ecn by date app
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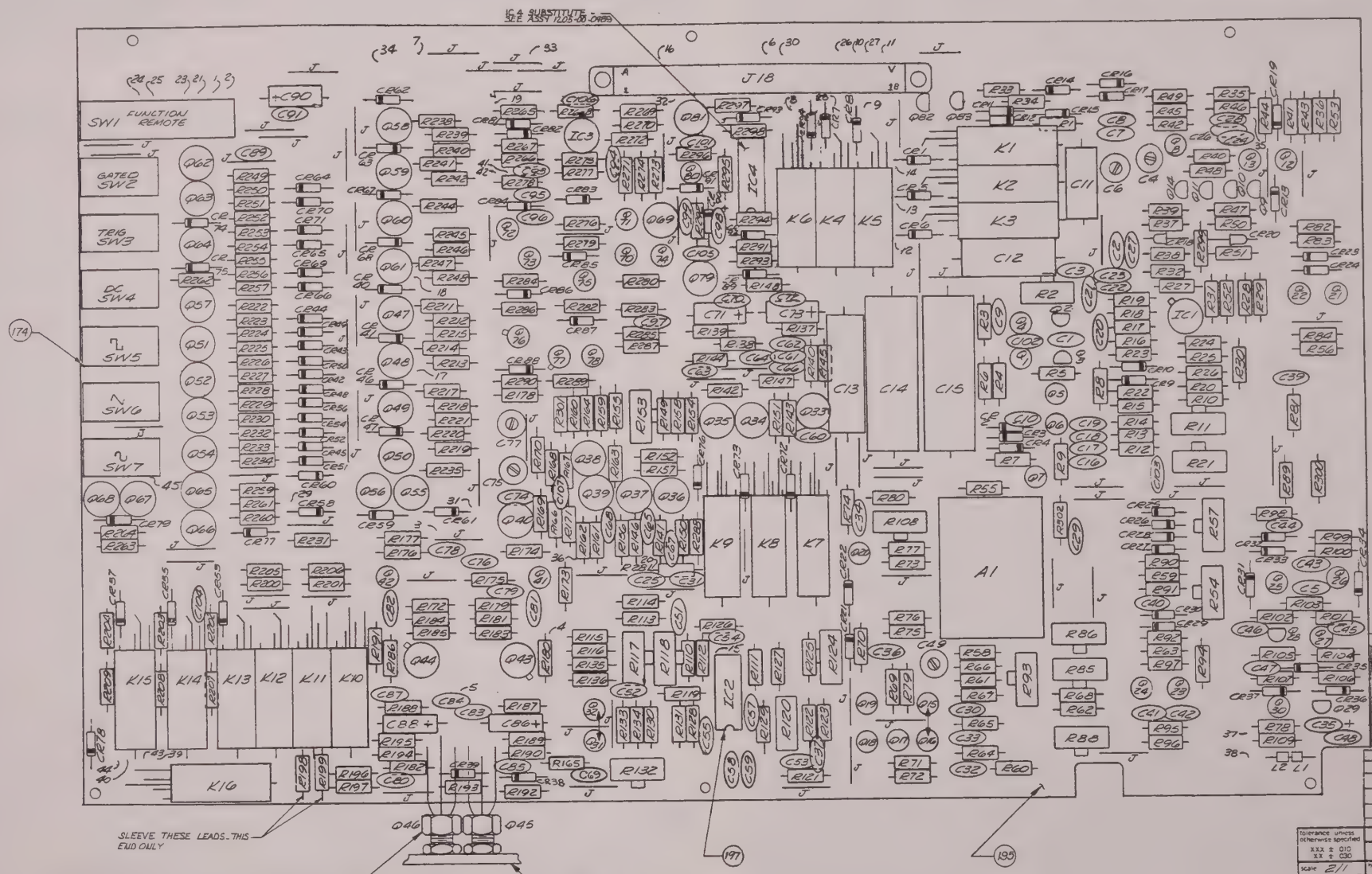

ltr	ecn	by	date
N	2171, 2735	LDV	6-9-81
M	ECN 1957	DVB	11-5-80
L	SEE ECN 1981, 2006 TEMPORARY MODIFICATION OF PC1		
M	ECN 1509	RD	1-3-77
L	ECN 1345	RD	8-10-76
K	ECN 1094	BD	9-16-76
J	ECN 894	BD	9-16-76
H	ECN 974	DM	7-7-76
G	ECN 772	DM	4-5-76
F	ECN 634	DM	4-5-76
E	ECN 575	B.D.	2-1-76
D	ECN 529	BD	12-15-75
C	ECN 481	BD	10-10-75
B	ECN 435	BD	8-14-75
A	ECN 417	BD	7-7-75

tolerance unless otherwise specified
XXX ± .010
XX ± .030
scale 2/1
material N/A
finish N/A

WAVETEK san diego, ca
by GRAY date 8-30-77 app C.S.
title ASSEMBLY, MAIN BOARD
model no. 154
dwg no 0101-00-0085
rev LP

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, MAIN	0101-00-0085	WVTK	0101-00-0085	1
NONE	SCHEMATIC, MAIN	0103-00-0085	WVTK	0103-00-0085	1
A1	SINE MOD	142-011	WVTK	1200-00-0002	1
J04	PATCH BLOCK	154-024	WVTK	1205-00-0489	1
C107	CAP. CER. 5PF, 1KV	DD-050 LONG LEAD	CRL	1500-00-5001	1
C40 C53 C64 C80 C93	CAP. CER. 5PF, 1KV	DD-050	CRL	1500-00-5011	5
C94	CAP. CER. 10PF, 1KV	DD-100	CRL	1500-01-0011	1
C81	CAP. CER. 100PF, 1KV	DD-101	CRL	1500-01-0111	1
C18 C21	CAP. CER. .001MF, 1KV	DD-102	CRL	1500-01-0211	2
C17 C102 C104 C25 C26 C28 C29 C34 C36 C41 C42 C47 C52 C55 C57 C60 C61 C62 C63 C66 C68 C69 C70 C72 C76 C78 C79 C81 C82 C85 C87 C88 C91 C95	CAP. CER. MIN., .01MF, 50V	CAC0225U103Z100A	CORNG	1500-01-0310	33
C1 C103 C105 C106 C24 C27 C39 C43 C48 C5 C54 C58 C59 C83 C84 C89	CAP. CER. MON., .1MF, 50V	CAC03Z5U104Z050A	CORNG	1500-01-0405	16
C37	CAP. CER. 15PF, 1KV	DD-150	CRL	1500-01-5011	1
C32	CAP. CER. 130PF, 1KV	DD-151	CRL	1500-01-5111	1

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | PAGE 1 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C4 C49 C6 C75 C77	VARI. 7-35PF, 250V	7S-TRIKO-02 7/35 PF	TRIKO	1500-53-5000	5
C35 C98	CAP, TANT. 22MF, 15V	196D226X9015KA1	SPRAG	1500-72-2601	2
C71 C73 C8o C88 C90	CAP, TANT. 5.6MF, 35V	150D565X9035B2	SPRAG	1500-75-6502	5
195	MAIN	134-113	WVTK	1700-00-0085	1
197	SKT, IC, 14PIN	C0814-01.	TI	2100-03-0011	1
J18	CONN, EDGE CARD	252-18-30-160	CINCH	2100-03-0013	1
NONE	HEAT SINK	207	WAKE	2800-11-0001	2
NONE	TRANSIPAD	10160	METRS	2800-11-0004	2
198	HEATSINK NUT	1103A	THERM	2800-11-0005	2
199	HEATSINK BODY	1103B	THERM	2800-11-0006	2
L1 L2	FERRITE BEAD	56-590-63/3B	FERRX	3100-00-0001	2
K1 K12 K13 K14 K15 K2 K3 K4 K5	RELAY, REED, FORM-A	FS-864	PHIPP	4500-00-0004	9
K10 K11 K16 K6 K7 K8 K9	RELAY, REED, FORM-C	FS-865	PHIPP	4500-00-0005	7
R108 R132 R153 R93	POT, TRIM, 100	91AR100	BECK	4600-01-0103	4
R54 R57	POT, TRIM, 1K	91AR1K	BECK	4600-01-0209	2
R117 R118 R86	POT, TRIM, 10K	91AR10K	BECK	4600-01-0315	3

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | PAGE 3 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R24 R28 R46	RES, MF, 1/8W, 1%, 1.21K	RN55D-1211F	TRW	4701-03-1211	3
R111 R231	RES, MF, 1/8W, 1%, 124	RN55D-1240F	TRW	4701-03-1240	2
R55	RES, MF, 1/8W, 1%, 150	RN55D-1500F	TRW	4701-03-1500	1
R152 R168 R273 R285 R295 R94 R97 R98	RES, MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	8
R155 R293 R294 R297	RES, MF, 1/8W, 1%, 15K	RN55D-1502F	TRW	4701-03-1502	4
R143 R144 R187 R188	RES, MF, 1/8W, 1%, 15	RN55D-15R0F	TRW	4701-03-1509	4
R183 R26 R3 P30	RES, MF, 1/8W, 1%, 1.62K	RN55D-1621F	TRW	4701-03-1621	4
R191 R99	RES, MF, 1/8W, 1%, 1.78K	RN55D-1781F	TRW	4701-03-1781	2
R163	RES, MF, 1/8W, 1%, 18.2K	RN55D-1822F	TRW	4701-03-1822	1
R125 R127 R133 R134 R211 R217 R238 R244 R259	RES, MF, 1/8W, 1%, 2K	RN55D-2001F	TRW	4701-03-2001	9
R212 R218 R239 R245 R260 R267	RES, MF, 1/8W, 1%, 21.5K	RN55D-2152F	TRW	4701-03-2152	6
R1 R12 R159 R164 R19 R27 R31 R66 R67	RES, MF, 1/8W, 1%, 21.5	RN55D-21R5F	TRW	4701-03-2159	9
R170	RES, MF, 1/8W, 1%, 221	RN55D-2210F	TRW	4701-03-2210	1
R147 R157 R167 R263 R264 R279 R292 R301	RES, MF, 1/8W, 1%, 2.21K	RN55D-2211F	TRW	4701-03-2211	8

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | PAGE 5 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C101 C3 C44 C45 C46 C47 C96 C99	CAP. CER. 22PF, 1KV	DD-220	CRL	1500-02-2011	8
C30	CAP. CER. 220PF, 1KV	DD-221	CRL	1500-02-2111	1
C74	CAP. CER. 30PF, 1KV	DD-300	CRL	1500-03-0001	1
C33	CAP. CER. 33PF, 1KV	DD-330	CRL	1500-03-3011	1
C65	CAP. CER. 330PF, 1KV	DD-331	CRL	1500-03-3111	1
C97	CAP. CER. 47PF, 1KV	DD-470	CRL	1500-04-7011	1
C51	CAP. CER. .005MF, 50V	CK-502	CRL	1500-05-0210	1
C20	CAP. CER. 68PF, 1KV	DD-680	CRL	1500-06-8001	1
C19 C22	CAP. MICA. 150PF, 500V	DM15-151J	ARCO	1500-11-5100	2
C27	CAP. MICA. 30PF, 500V	DM13-300J	ARCO	1500-13-0000	1
C87	CAP. MICA. 68PF, 500V	DM15-680F	ARCO	1500-16-8001	1
C7	CAP. MICA. 820PF, 300V	DM15-821F	ARCO	1500-18-2101	1
C17 C22	CAP. MICA. 91PF, 500V	DM15-910J	ARCO	1500-19-1000	2
C11	CAP. POLYC. .01MF, 100V	PA2B103F	ELCUB	1500-41-0304	1
C12	CAP. POLYC. .1MF, 100V	PA2B104F	ELCUB	1500-41-0404	1
C13	CAP. POLYC. 1MF, 100V	210-81C-105F	IMB	1500-41-0504	1
C14 C15	CAP. POLYC. 5MF, 100V	C1A505F	ELPAC	1500-45-0504	2

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | PAGE 2 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R120 R124	POT, TRIM, 100K	91AR100K	BECK	4600-01-0402	2
R2	POT, TRIM, 200	91AR200	BECK	4600-02-0101	1
R11 R21 R85 P86	POT, TRIM, 500	91AR500	BECK	4600-05-0104	4
R165 R192 R193	RES, C, 1/2W, 5%, 10	RC20GF-100	STKPL	4700-25-0100	3
R189 R190 R194 R195	RES, C, 1/2W, 5%, 27	RC20GF-270	STKPL	4700-25-0270	4
R8 R9 R95 R96	RES, C, 1/2W, 5%, 8.2	RC20GF-8R2	STKPL	4700-25-0829	4
R100 P109 R131 R154 R272 R274 R299 R32 R33 R34 R5 R52 R6 R78 R81 R89	RES, MF, 1/8W, 1%, 100	RN55D-1000F	TRW	4701-03-1000	16
R106 R107 R114 R115	RES, MF, 1/8W, 1%, 1K	RN55D-1001F	TRW	4701-03-1001	4
R113 R116 R13 R135 R136 P140 R142 R174 R176 R179 R18 R265 R266 R280 R283 R287 R298	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	17
R213 R219 R222 R225 R226 R232 R242 R248 R244 R252 R255 R262 R288 R60	RES, MF, 1/8W, 1%, 100K	RN55D-1003F	TRW	4701-03-1003	14
R56 R75 R76 R80 R84	RES, MF, 1/8W, 1%, 10	RN55D-10R0F	TRW	4701-03-1009	5
R40 R48	RES, MF, 1/8W, 1%, 1.1K	RN55D-1101F	TRW	4701-03-1101	2

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | PAGE 4 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R286	RES, MF, 1/8W, 1%, 221K	RN55D-2213F	TRW	4701-03-2213	1
R130 R282 R289 R35 R43 R53 R68 R73	RES, MF, 1/8W, 1%, 2.37K	RN55D-2371F	TRW	4701-03-2371	8
R268	RES, MF, 1/8W, 1%, 23.7K	RN55D-2372F	TRW	4701-03-2372	1
R281	RES, MF, 1/8W, 1%, 237K	RN55D-2373F	TRW	4701-03-2373	1
R180 R186 R202 R38 R39 R47 R51	RES, MF, 1/8W, 1%, 249	RN55D-2490F	TRW	4701-03-2490	7
R203 R278 R59 R90	RES, MF, 1/8W, 1%, 2.49K	RN55D-2491F	TRW	4701-03-2491	4
R204	RES, MF, 1/8W, 1%, 24.9K	RN55D-2492F	TRW	4701-03-2492	1
R110 R112 R119 R64	RES, MF, 1/8W, 1%, 274	RN55D-2740F	TRW	4701-03-2740	4
R214 R215 R220 R221 R240 R241 R246 R247 R261	RES, MF, 1/8W, 1%, 27.4K	RN55D-2742F	TRW	4701-03-2742	9
R104 R156 R162	RES, MF, 1/8W, 1%, 2.87K	RN55D-2871F	TRW	4701-03-2871	3
R150 P166 R178	RES, MF, 1/8W, 1%, 3.01K	RN55D-3011F	TRW	4701-03-3011	3
R15 P16 R182 R22 R23 R91	RES, MF, 1/8W, 1%, 316	RN55D-3160F	TRW	4701-03-3160	6
R122 R158 R4	RES, MF, 1/8W, 1%, 3.32K	RN55D-3321F	TRW	4701-03-3321	3
R223 R224 R226 R227 R229 R230 R233 R234	RES, MF, 1/8W, 1%, 33.2K	RN55D-3322F	TRW	4701-03-3322	14

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | PAGE 6 | REV S

NOTE. UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: PARTS LIST MAIN BOARD
FINISH: WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 XX ± .030 ANGLES ± 1°		
	DO NOT SCALE DWG		MODEL NO. 154 | DWG NO. 1100-00-0085 | REV S
	SCALE		CODE IDENT 23338 | SHEET 1 OF 2

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY PURPOSE EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R200 R205	RES. MF. 1/8W. 1%. 54.9	RN55D-54R9F	TRW	4701-03-5499	2
R126 R69 R71 R72	RES. MF. 1/8W. 1%. 56.2	RN55D-56R2F	TRW	4701-03-5629	4
R181 R184	RES. MF. 1/8W. 1%. 576	RN55D-5760F	TRW	4701-03-5760	2
R291	RES. MF. 1/8W. 1%. 5.76K	RN55D-5761F	TRW	4701-03-5761	1
R25 R29	RES. MF. 1/8W. 1%. 6.19K	RN55D-6191F	TRW	4701-03-6191	2
R169 R207	RES. MF. 1/8W. 1%. 61.9	RN55D-61R9F	TRW	4701-03-6199	2
R149	RES. MF. 1/8W. 1%. 6.81K	RN55D-6811F	TRW	4701-03-6811	1
R128 R129	RES. MF. 1/8W. 1%. 6.98K	RN55D-6981F	TRW	4701-03-6981	2
R151	RES. MF. 1/8W. 1%. 69.8K	RN55D-6982F	TRW	4701-03-6982	1
R14 R17	RES. MF. 1/8W. 1%. 7.5K	RN55D-7501F	TRW	4701-03-7501	2
R26 R270 R275 R277 R62	RES. MF. 1/8W. 1%. 825	RN55D-8250F	TRW	4701-03-8250	5
R123 R160 R172 R63 R82 R83 R92	RES. MF. 1/8W. 1%. 8.25K	RN55D-8251F	TRW	4701-03-8251	7
R302	RES. MF. 1/8W. 1%. 82.5	RN55D-82R5F	TRW	4701-03-8239	1
R37 R50	RES. MF. 1/8W. 1%. 90.9	RN55D-90R9F	TRW	4701-03-9099	2
R36	RES. MF. 1/4W. 1%. 196	RN60D-1960F	TRW	4701-13-1960	1
R49	RES. MF. 1/4W. 1%. 332	RN60D-3320F	TRW	4701-13-3320	1

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO 1100-00-0085 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
CR88 CR89 CR90 CR91 CR92 CR93 CR94					
CR11 CR12	DIODE, SET, 2-FD-777 QTY 2 4807-02-0777	142-501-38	WVTK	4898-00-0003	1
Q76 Q77	TRANS	2N2369A	MOT	4901-02-3691	2
Q43 Q46	TRANS	2N2905A	NSC	4901-02-9051	2
Q41 Q5	TRANS	2N3563	FAIR	4901-03-5630	2
Q33 Q35 Q37 Q39 Q47 Q48 Q49 Q50 Q51 Q52 Q53 Q54 Q58 Q59 Q60 Q61 Q62 Q63 Q64 Q65 Q66 Q68 Q69 Q79 Q81	TRANS	2N6388A	CARTR	4901-03-6381	25
Q1 Q42 Q70 Q71	TRANS	2N3640	FAIR	4901-03-6400	4
Q34 Q36 Q40 Q55 Q56 Q57 Q67	TRANS	2N3643	FAIR	4901-03-6430	7
Q19 Q21 Q23 Q25 Q26 Q27 Q30 Q4 Q6 Q72 Q73 Q74 Q75 Q78 Q80	TRANS	2N3646	NSC	4901-03-6460	15
Q12 Q13 Q17 Q18 Q20 Q22 Q24 Q7 Q8	TRANS	2N5139	FAIR	4901-05-1390	9
Q83	TRANS	2N3486	MOT	4901-05-4860	1
Q10 Q11 Q14 Q28 Q29 Q9	TRANS	2N5771	NSC	4901-05-7710	6

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R250 R251 R253 R254 R256 R257					
R300 R58 R74 R77	RES. MF. 1/8W. 1%. 33.2	RN55D-33R2F	TRW	4701-03-3329	4
R10 R20	RES. MF. 1/8W. 1%. 3.65K	RN55D-3651F	TRW	4701-03-3651	2
R296	RES. MF. 1/8W. 1%. 3.83K	RN55D-3831F	TRW	4701-03-3831	1
R138 R175	RES. MF. 1/8W. 1%. 38.3K	RN55D-3832F	TRW	4701-03-3832	2
R103	RES. MF. 1/8W. 1%. 392	RN55D-3920F	TRW	4701-03-3920	1
R105 R161 R7	RES. MF. 1/8W. 1%. 3.92K	RN55D-3921F	TRW	4701-03-3921	3
R137 R139 R173 R177	RES. MF. 1/8W. 1%. 4.02K	RN55D-4021F	TRW	4701-03-4021	4
R44T	RES. MF. 1/8W. 1%. 4.32K	RN55D-4321F	TRW	4701-03-4321	1
R70 R79	RES. MF. 1/8W. 1%. 464	RN55D-4640F	TRW	4701-03-4640	2
R101 R102	RES. MF. 1.8W. 1%. 46.4	RN55D-46R4F	TRW	4701-03-4649	2
R146 R271	RES. MF. 1/8W. 1%. 4.75K	RN55D-4751F	TRW	4701-03-4751	2
R121 R235 R276 R284 R290	RES. MF. 1/8W. 1%. 47.5K	RN55D-4752F	TRW	4701-03-4752	5
R145 R148 R41	RES. MF. 1/8. 1%. 499	RN55D-4990F	TRW	4701-03-4990	3
R185	RES. MF. 1/8W. 1%. 4.99K	RN55D-4991F	TRW	4701-03-4991	1
R42 R45 R61 R65	RES. MF. 1/8W. 1%. 511	RN55D-5110F	TRW	4701-03-5110	4
R206	RES. MF. 1/8W. 1%. 51.1	RN55D-51R1F	TRW	4701-03-5119	1

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R196 R197 R198 R199 R200	RES. MF. 1/4W. 1%. 49.9	RN60D-49R9F	TRW	4701-13-4999	5
R201 R206	RES. MF. 1/4W. 1%. 71.5	RN60D-71R5F	TRW	4701-13-7159	2
R141 R171	RES. SET. 2-10K. 1/8W QTY 2: 4701-03-1002	142-501-64	WVTK	4789-00-0018	1
CR13 CR2 CR83	DIODE, ZENER 6.2V	1N823A	NPC	4801-01-0823	3
CR18 CR20	DIODE	1N3716	GE	4802-01-3716	2
CR10 CR14 CR15 CR16 CR17 CR25 CR26 CR27 CR28 CR34 CR9	DIODE	FD777	FAIR	4807-02-0777	11
CR1 CR19 CR21 CR22 CR23 CR24 CR29 CR3 CR30 CR31 CR32 CR33 CR35 CR36 CR37 CR38 CR39 CR4 CR40 CR41 CR42 CR43 CR44 CR45 CR46 CR47 CR48 CR49 CR5 CR50 CR51 CR52 CR53 CR54 CR55 CR56 CR57 CR58 CR59 CR6 CR60 CR61 CR62 CR63 CR64 CR65 CR66 CR67 CR68 CR69 CR7 CR70 CR71 CR72 CR73 CR74 CR75 CR76 CR77 CR78 CR79 CR8 CR81 CR82 CR84 CR85 CR86 CR87	DIODE	1N4148	FAIR	4807-02-6666	75

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | REV S

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q44 Q45	TRANS. SEL. 2N2219A QTY 1: 4901-02-2191	142-501-66	WVTK	4998-00-0001	2
Q15 Q16 Q31 Q32	TRANS. M/PR. 2N3563 QTY 2 4901-03-5630	142-501-52	WVTK	4998-00-0004	2
Q82	TRANS. SEL. 2N5462 QTY 1 4901-05-4620	142-501-55	WVTK	4998-00-0008	1
Q2 Q3	TRANS, M/PR. 2N5485 QTY. 2 4901-05-4850	142-501-53	WVTK	4998-00-0009	1
174	SWITCH ASSY PB	134-404	WVTK	5103-00-0007	1
NONE	BUTTON	J-52305-BLACK	CRL	5103-04-0003	7
Q38	IC	AD 812	ANDEV	7000-08-1200	1
IC2	IC	MC1595L	MOT	7000-15-9500	1
IC3	IC	CA-3028A	RCA	7000-30-2800	1
IC1	IC	CA3049T	RCA	7000-30-4900	1

WAVETEK PARTS LIST | TITLE MAIN | ASSEMBLY NO. 1100-00-0085 | REV S

NOTE. UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DRAWN | DATE | PROJ ENGR | RELEASE APPROV | TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1° XX ±.030 | DO NOT SCALE DWG | SCALE

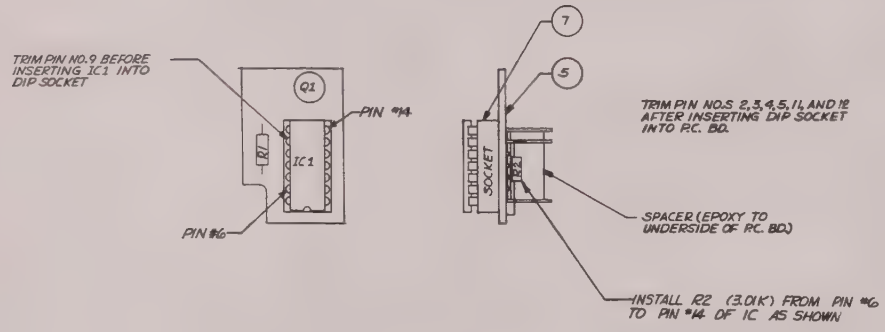
WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PARTS LIST MAIN BOARD

MODEL NO 154 | DWG NO 1100-00-0085 | REV S | CODE IDENT NO 23338 | SHEET 2 OF 2

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV	ECN	BY	DATE	APP
A	ECN NO. 1472	RO	9-28-78	
B	REDRAWN (NO CHANGES)	DC	12579	
C	# 1999	BB	7-17-79	JO

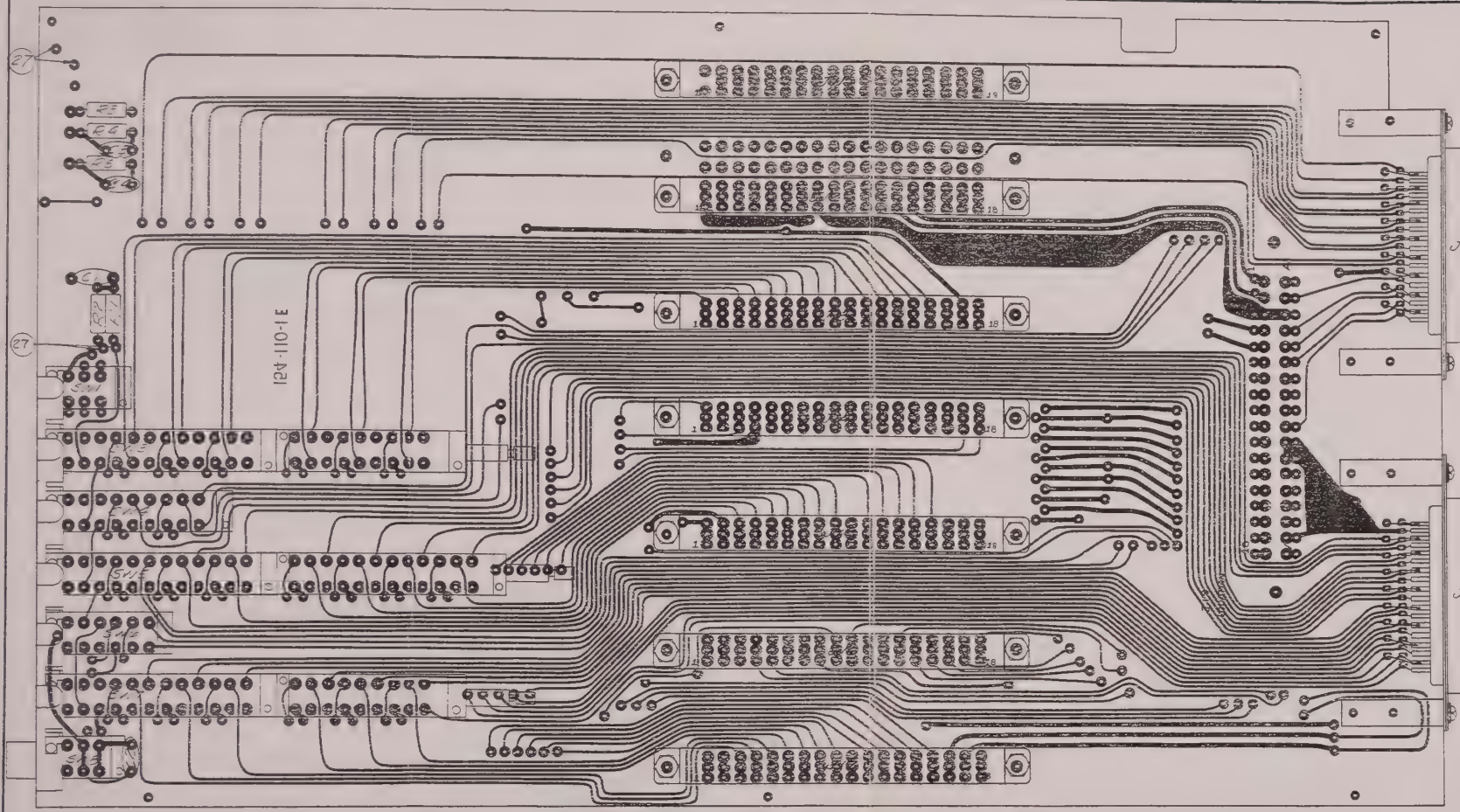

TRIM PIN NO. 9 BEFORE INSERTING IC1 INTO DIP SOCKET
Q1
PIN #14
R1
IC1
PIN #6
7
5
SOCKET
TRIM PIN NO.S 2,3,4,5,11, AND 12 AFTER INSERTING DIP SOCKET INTO P.C. BD.
SPACER (EPOXY TO UNDERSIDE OF P.C. BD.)
INSTALL R2 (3.01K) FROM PIN #6 TO PIN #14 OF IC AS SHOWN

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
3	SPACER	1400-00-6641	WVTK	1400-00-6641	1
5	CHIP REPLACEMENT BD	154-124	WVTK	1700-00-0489	1
7	SKT. IC, 14PIN. WW	CSA2200-148C	SAE	2100-03-0002	1
R2	RES. MF, 1/8W, 1%, 3.01K	RN55D-3011F	TRW	4701-03-3011	1
R1	RES. MF, 1/8W, 1%, 4.99K	RN55D-4991F	TRW	4701-03-4991	1
Q1	TRANS	2N3646	NSC	4901-03-6460	1
IC1	IC	74LS74	TI	8000-74-7410	1

WAVETEK PARTS LIST	TITLE PATCH BLOCK	ASSEMBLY NO. 1205-00-0489 PAGE 1	REV C

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 12579	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PATCH BLOCK
FINISH WAVETEK PROCESS	RELEASE APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030	
	DO NOT SCALE DWG		MODEL NO. 144, 146 / 154
	SCALE		DWG NO. 1205-00-0489 REV C
			CODE IDENT 23338 SHEET 2 OF 2



PARTS LIST

Item	Reference	Description	Mfgr	Mfgr No	Qty
1		CAPACITORS			
2	C3,C4	CERAMIC DISC, 100DV, 33pF	CRL	DD330	2
3	C2	50V, .01uF		CK103	1
4	C1	20%, .1uF		UK20-104	1
5					
6		RESISTORS			
7	R2	CAP3011 1/2W, 10%, 3.9K	STACKPOLE	RCP09F392K	1
8	R1	10K		103K	1
9					
10	R3-R5	METAL FILM, 1/4W, 1%, 3.32K	CORNING	RN60D	3
11					
12					
13					
14	SW1, SW3-SW8	SWITCH ASSY	WAVETEK	B154-405	1
15					
16					

PARTS LIST

Item	Reference	Description	Mfgr	Mfgr No	Qty
17	J11-J17	CONNECTORS	SIGNAL	252-18-30-160	7
18	J2, J3		AMPHENOL	57-40360	2
19					
20					
21					
22					
23		CONNECTOR BLOCKS	WAVETEK	A154-3J0	4
24					
25					
26		CIRCUIT BOARD	WAVETEK	154-110E	1
27					2
28					
29					
30					
31					
32					
33					

rev	ecn	by	date	app
F	ECN 1095	Bo	9-16-74	
E	ECN 994	Jln	6-14-74	
D	ECN 528	J.Lynch	12-15-73	
C	ECN 476	Bo	6-7-73	
B	ECN 435	[illegible]	[illegible]	
A	ECN 417	[illegible]	[illegible]	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale 2/1 | by GRAV | date 10-21-71 | app'd

material: N/A

finish: N/A

title: ASSY, MOTHER BOARD

model no. 154 | dwg no. 0154-010 | rev F

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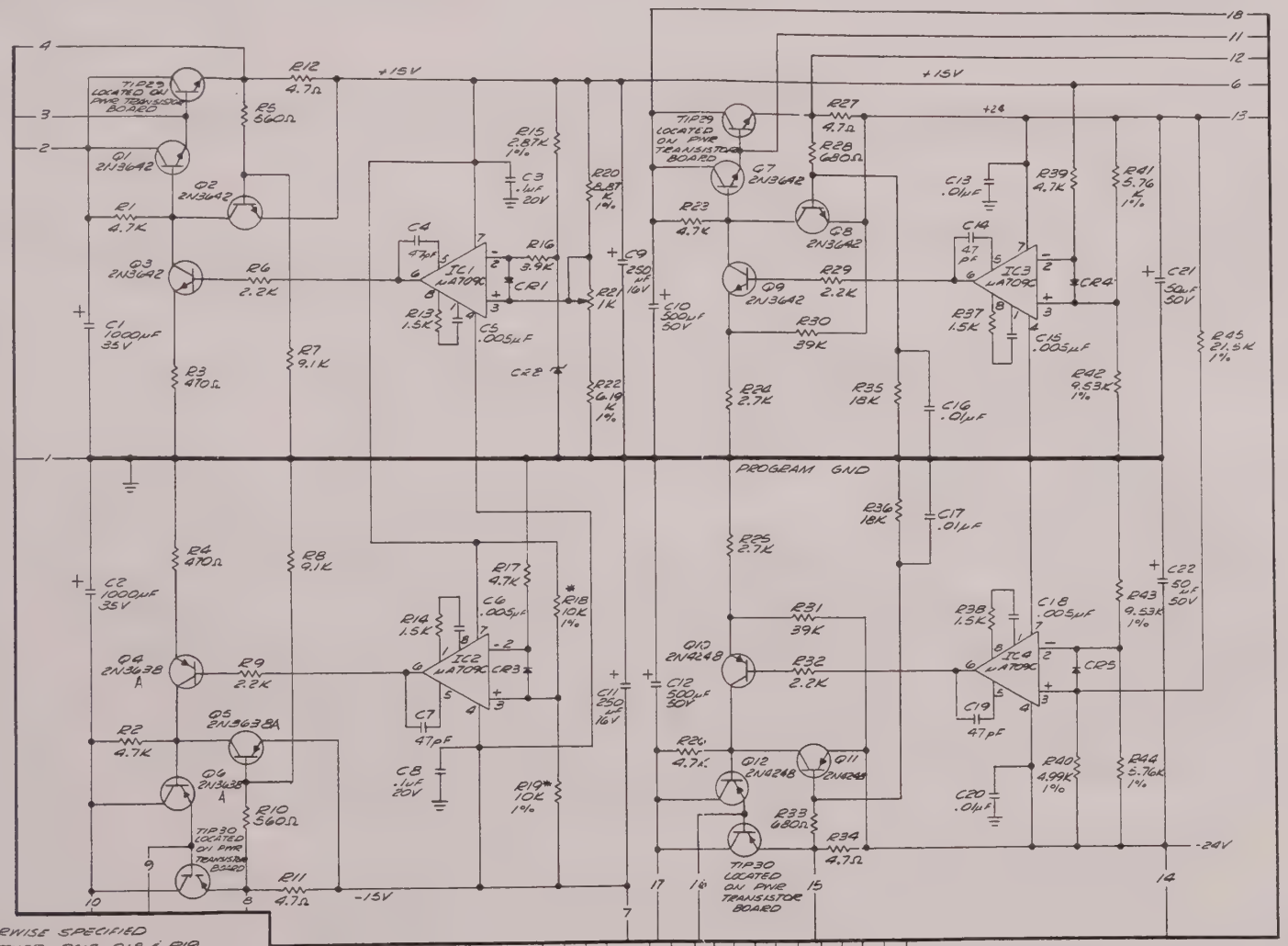
REV	ECN	BY	DATE	APP

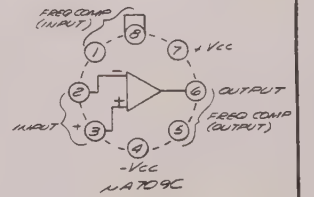
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SCHEMATIC, INSTRUMENT	0004-00-0041	WVTK	0004-00-0041	1
NONE	ASSY DRWG. MOTHER	0101-00-0080	WVTK	0101-00-0080	1
J3	BLOCK, CONN	134-306	WVTK	1400-00-2873	4
C1 C2	CAP, CER, MON., 1MF, 30V	CAC03Z3U104Z030A	CORNG	1500-01-0405	2
C3 C4	CAP, CER, 33PF, 1KV	DD-330	CRL	1500-03-3011	2
NONE	MOTHER	134-110	WVTK	1700-00-0080	1
J2 J3	CONN	57-40360	AMPH	2100-02-0040	2
J11 J12 J13 J14 J15 J16 J17	CONN, EDGE CARD	252-18-30-160	CINCH	2100-03-0013	7
27	LAMP	7876	JKL	2400-02-0013	2
R1	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	1
R3 R4 R5	RES, MF, 1/8W, 1%, 3.32K	RN55D-3321F	TRW	4701-03-3321	3
R2	RES, MF, 1/8W, 1%, 3.92K	RN55D-3921F	TRW	4701-03-3921	1
I4	SWITCH ASSY PB	134-405	WVTK	5103-00-0008	1
I5	BUTTON	J-32303-BLACK	CRL	5103-04-0003	7

WAVETEK PARTS LIST	TITLE MOTHER	ASSEMBLY NO. 1100-00-0080 PAGE. 1	REV C

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE MOTHER BOARD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.030 ANGLES ±1°		MODEL NO 154 / DWG NO 1100-00-0080 / REV G
	DO NOT SCALE DWG		
	SCALE		CODE IDENT 23338 / SHEET 1 OF 1





NOTES: UNLESS OTHERWISE SPECIFIED
1. * INDICATES MATCHED PAIR. R18 & R19
2. RESISTORS ARE CARBON, 1/8W, 1%
3. DIODES ARE FD6666

LAST REF DESIG
R45 IC4
C22 Q12
CR5

D	ECN 1857	SAH	11-29-78
C	ECN 1599	BD	8/1/77
B	ECN 1391	ED	1-7-76
A	ECN 435	[illegible]	[illegible]

tolerance unless otherwise specified	rev	ecn	by date app.
.XXX ± .010 .XX ± .030	WAVETEK san diego, calif		
scale N/A	by GRAY date 5-26-71 app. K S		
material N/A	title SCHEMATIC, 15V, 24V POWER SUPPLY		
finish N/A	model no. 154	dwg. no. 0103-00-0081	rev D

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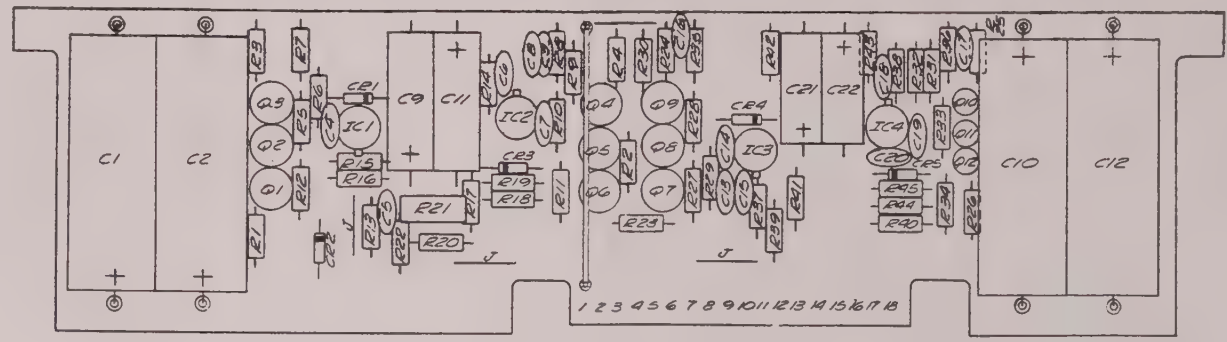

NOTE: R5 & R10;
WHEN USING 1/8 WATT RESISTORS
THESE VALUES SHOULD BE 68Ω

rev	ecn	by	date	app.
C	ECN 1857	DNB	7/13/78	
B	ECN 1381	RD	1-12-78	
A	470		8/24/77	

tolerance unless otherwise specified
XXX ± .010
XX ± .030

WAVETEK san diego, calif

scale 2/1 | by GEAY | date 6-22-77 | app.

material N/A

finish N/A

title ASSEMBLY, 15V, 24V POWER SUPPLY

model no 154 | dwg no 0101-00-0081 | rev C

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATIONS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
NONE	ASST DWG,POWER	0101-00-0081	WVTK	0101-00-0081	1
NONE	SCHEMATIC,POWER	0103-00-0081	WVTK	0103-00-0081	1
C13 C16 C17 C20	CAP,CER,.01MF,50V	CK-103	CRL	1500-01-0310	4
C3 C4	CAP,CER,.1MF,20V	UK20-104	CRL	1500-01-0413	2
C18 C19 C4 C7	CAP,CER,.47PF,1KV	DD-470	ARCO	1500-03-7011	4
C15 C18 C5 C6	CAP,CER,.005MF,50V	CK-502	CRL	1500-05-0210	4
C1 C2	CAP,ELECT,1000MF,35V	39D108G035GL6	SPRAG	1560-31-0212	2
C11 C9	CAP,ELECT,250MF,18V	500D257G018DF7	SPRAG	1560-32-5101	2
C21 C22	CAP,ELECT,50MF,50V	500D506A050DU7	SPRAG	1560-35-0003	2
C10 C12	CAP,ELECT,500MF,5UV	39D507G050GL6	SPRAG	1560-34-0103	2
NONE	POWER	154-111	WVTK	1760-00-0081	1
NONE	TRANSFORMER	10123A	METRO	2000-11-0003	1
RP1	POT,TRIM,1K	91A1B	MEPC	0010-01-0209	1
R11 R12 R27 R36	RES,C,1/2W,5%,8.7	RC20GF-8R7	STKPL	0700-25-0479	4
R13 R14 R37 R38	RES,MF,1/8W,1%,1.5K	MN55D-1501F	IRC	0701-03-1501	4
R35 R39	RES,MF,1/8W,1%,18.2K	MN55D-1822F	IRC	0701-03-1822	2
R45	RES,MF,1/8W,1%,21.5K	MN55D-2152F	TRW	0701-03-2152	1
R29 R32 R6 R9	RES,MF,1/8W,1%,2.21K	MN55D-2211F	TRW	0701-03-2211	4

WAVETEK PARTS LIST	TITLE 15V POWER	MODEL NO. 1100-00-0081	REV D
		PAGE: 1	

REFERENCE DESIGNATIONS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
Q10 Q11 Q12	TRANS	2N4208	FAIR	4901-04-2080	3
IC1 IC2 IC3 IC8	IC,CLASS II,MA4709 QTY12:7000-07-0000	130-501-10	WVTK	7200-00-0006	4

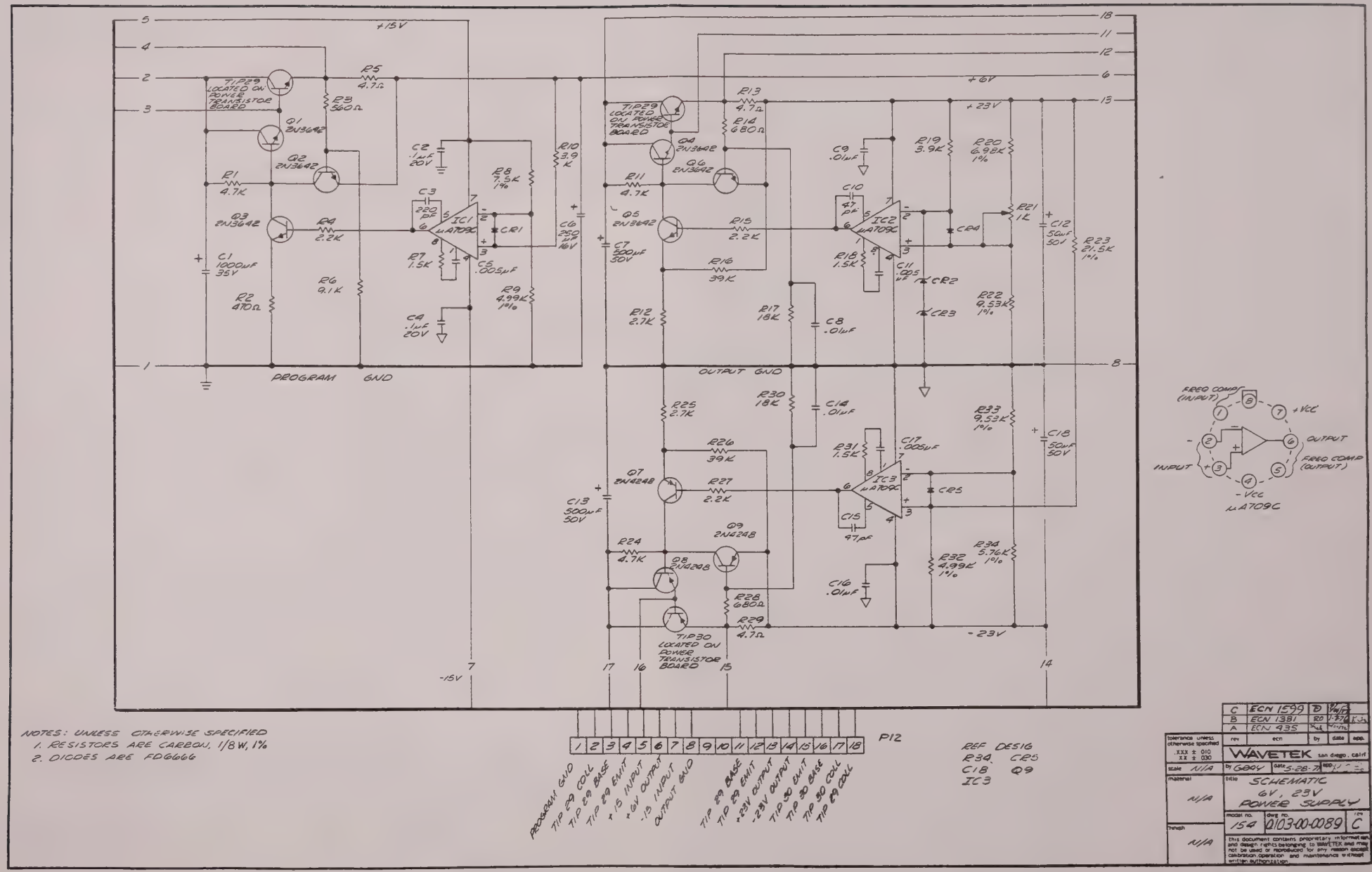
WAVETEK PARTS LIST	TITLE 15V POWER	MODEL NO. 1100-00-0081	REV D
		PAGE: 3	

REFERENCE DESIGNATIONS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
R15 R24 R25	RES,MF,1/8W,1%,2.87K	MN55D-2871F	TRW	0701-03-2871	3
R16	RES,MF,1/8W,1%,5.83K	MN55D-5831F	IRC	0701-03-5831	1
R30 R31	RES,MF,1/8W,1%,38.3K	MN55D-3832F	IRC	0701-03-3832	2
R5 R8	RES,MF,1/8W,1%,404	MN55D-4040F	IRC	0701-03-4040	2
R1 R17 R2 R23 R26 R39	RES,MF,1/8W,1%,8.75K	MN55D-8751F	TRW	0701-03-8751	6
R33	RES,MF,1/8W,1%,3.96K	MN55D-4001F	TRW	0701-03-4001	1
R21 R44	RES,MF,1/8W,1%,5.76K	MN55D-5761F	TRW	0701-03-5761	2
R22	RES,MF,1/8W,1%,6.19K	MN55D-6191F	TRW	0701-03-6191	1
R10 R28 R33 R5	RES,MF,1/8W,1%,681	MN55D-6810F	TRW	0701-03-6810	4
R20	RES,MF,1/8W,1%,8.87K	MN55D-8871F	IRC	0701-03-8871	1
R7 R8	RES,MF,1/8W,1%,9.09K	MN55D-9091F	TRW	0701-03-9091	2
R42 R43	RES,MF,1/8W,1%,9.53K	MN55D-9531F	TRW	0701-03-9531	2
R19 R19	RES,SET,2-10K,1/8W QTY12:4701-03-1002	102-501-08	WVTK	4709-00-2018	1
CR2	DIODE	1N4581	MICRO	4601-01-4581	1
CR1 CR3 CR4 CR5	DIODE	FD-6666	FAIR	4807-02-6666	4
Q4 Q5 Q6	TRANS	2N3638A	EARTH	4901-03-0381	3
Q1 Q2 Q3 Q7 Q8 Q9	TRANS	2N3642	FAIR	4901-03-0420	6

WAVETEK PARTS LIST	TITLE 15V POWER	MODEL NO. 1100-00-0081	REV D
		PAGE: 2	

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA		
MATERIAL	PROJ ENGR		TITLE 15V, 24V POWER SUPPLY		
	RELEASE APPROV				
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.030 ANGLES ±1				
	DO NOT SCALE DWG		MODEL NO. 154	DWG NO. 1100-00-0081	REV D
	SCALE		TOOL IDENT 23338	SHEET OF	

NOTE: UNLESS OTHERWISE SPECIFIED



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE CARBON, 1/8 W, 1%
2. DIODES ARE FDG666

REF DESIG
R34, CR5
C18 Q9
IC3

rev	ecn	by	date	app.
C	ECN 1599	D	7-76	
B	ECN 1381	RO	1-76	
A	ECN 935			

tolerance unless otherwise specified: XXX ± .010, XX ± .030

WAVETEK san diego, calif

scale N/A | by GRAY | date 5-28-75 | app.

material N/A

finish N/A

title: SCHEMATIC 6V, 23V POWER SUPPLY

model no. 154 | dwg no. 0103-00-0089 | rev C

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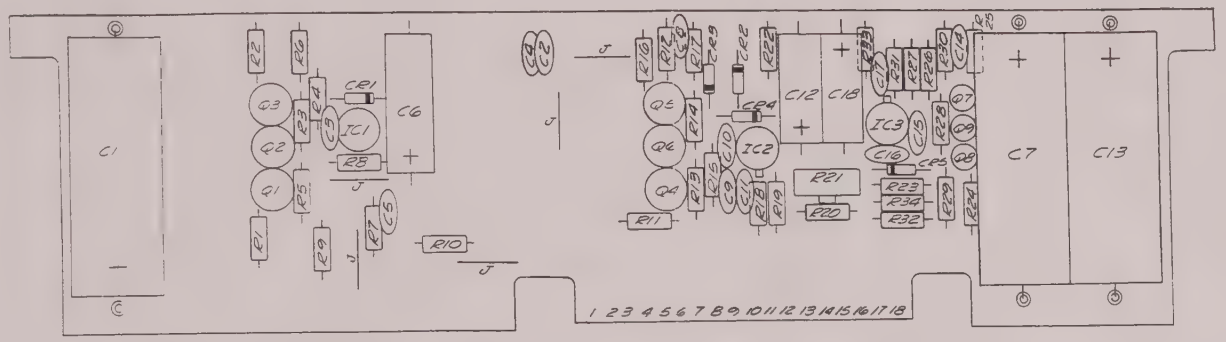

PARTS LIST

Item	REF DES	DESCRIPTION	MFGR	MFGR NO.	Qty
1		CAPACITORS			
2	C3	CERAMIC, 1000V, 10%, 220pf	CRL	CD221	1
3	C5, C11, C17	50V, .005μf		CK-502	3
4	C8, C9, C14, C16	50V .01μF		CK-103	4
5	C2, C4	20V .1μF		UK-20-104	2
6	C12, C18	ELECTROLYTIC, 30V, 10%, 50μF	SPRAGUE	5000 5066 DS0005	2
7	C6	16V, 250μF		5000 3576 DD1F7	1
8	C7, C13	30V 500μF		3900 6706 DS0569	2
9	C1	35V 1000μF		3900 1086 DS0534	1
10	C10, C15	CERAMIC 1000V, 10% 47pf	CRL	DD470	2
11					
12					
13		DIODES			
14	CR1, CR4, CR5	FD6666	FAIRCHILD	FD6666	3
15	CR2, CR3	ZENER	WAVETEK	130-506	2
16					
17					
18					
19		INTEGRATED CIRCUITS			
20	IC1-IC3	-14	FAIRCHILD	μA709C	3
21					
22					
23	R21	POTENTIOMETERS 1K	CRL	BA1603-803	1
24					
25					
26		RESISTORS			
27	R5, R13, R29	CARBON, 1/2W, 5%, 9.7Ω	STACKPOLE	RC20GF9R7J	3
28	R22	10% 470Ω		471K	1
29	R3	560Ω		561K	1
30	R14, R28	680Ω		681K	2
31	R7, R18 R31	1.5K		152K	3
32	R4 R15, R27	2.2K		222K	3
33	R12, R25	2.7K		272K	2
34	R10, R19	3.9K		392K	2
35	R1, R11, R24	5% 4.7K		472J	3
36	R6	9.1K		912J	1
37	R17, R30	18K		183J	2
38	R16, R26	10% 39K		393K	2
39					
40					
41					
42					
43					

PARTS LIST

Item	REF DES	DESCRIPTION	MFGR	MFGR NO	Qty
44		RESISTORS			
45	R29, R32	METAL FILM, 1/4W, 1%, 4.99K	CORNING	RN60D	2
46	R34	5.76K			1
47	R20	6.98K			1
48	R8	7.5K			1
49	R22, R33	19.53K			2
50	R23	21.5K			1
51					
52					
53					
54		TRANSISTORS			
55	Q1-Q6	2N3642	FAIRCHILD	2N3642	6
56	Q7-Q9	2NA248		2N4248	3
57					
58					
59					
60					
61		CIRCUIT BOARD	WAVETEK	154-1118	1
62					
63					
64					
65					
66					
67					

	A	ECN 1381	ED	6-21-74
	REV	BY	CO #	DATE

WAVETEK SAN DIEGO, CA.

DR GEAY 6-21-74

TITLE: ASSEMBLY 6V 23V POWER SUPPLY

MODEL NO. 154 | DWG NO. D54-021 | REV A

MATERIAL N/A

FINISH N/A

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	UNIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DWG, POWER	0101-00-0089	WVTK	0101-00-0089	1
NONE	SCHEMATIC, POWER	0103-00-0089	WVTK	0103-00-0089	1
C14 C16 C8 C9	CAP,CER,.01MF,50V	CK-103	CML	1500-01-0310	4
C2 C4	CAP,CER,.1MF,20V	UK20-104	AMCO	1500-01-0413	2
C3	CAP,CER,220PF,1KV	DD-221	CML	1500-02-2111	1
C10 C15	CAP,CER,470PF,1KV	DD-470	CML	1500-00-7011	2
C11 C17 C5	CAP,CER,.003MF,50V	CK-502	CML	1500-03-0210	3
C1	CAP,ELECT,1000MF,35V	3WD10B4035GLB	SPRAG	1500-31-0212	1
C6	CAP,ELECT,250MF,10V	500D257G010AD7	SPRAG	1500-32-5101	1
C12 C18	CAP,ELECT,50MF,50V	500D506G050DD7	SPRAG	1500-33-0003	2
C13 C7	CAP,ELECT,500MF,50V	3WD507G050GLW	SPRAG	1500-33-0103	2
NONE	POWER	150-111	WVTK	1700-00-0081	1
R21	POT,TRIM,1K	91A1A	HECA	4000-01-0209	1
R13 R29 R5	RES,C,1/2W,5%,4.7	RC20GF4R7	STKPL	4700-25-4479	3
R18 R31 R7	RES,MF,1/8W,1%,1.5K	MN55D-1501F	TWA	4701-03-1501	3
R17 R30	RES,MF,1/8W,1%,18.2K	MN55D-1822F	TWA	4701-03-1822	2
R23	RES,MF,1/8W,1%,21.5K	MN55D-2152F	TWA	4701-03-2152	1
R15 R27 R6	RES,MF,1/8W,1%,2.21K	MN55D-2211F	TWA	4701-03-2211	3

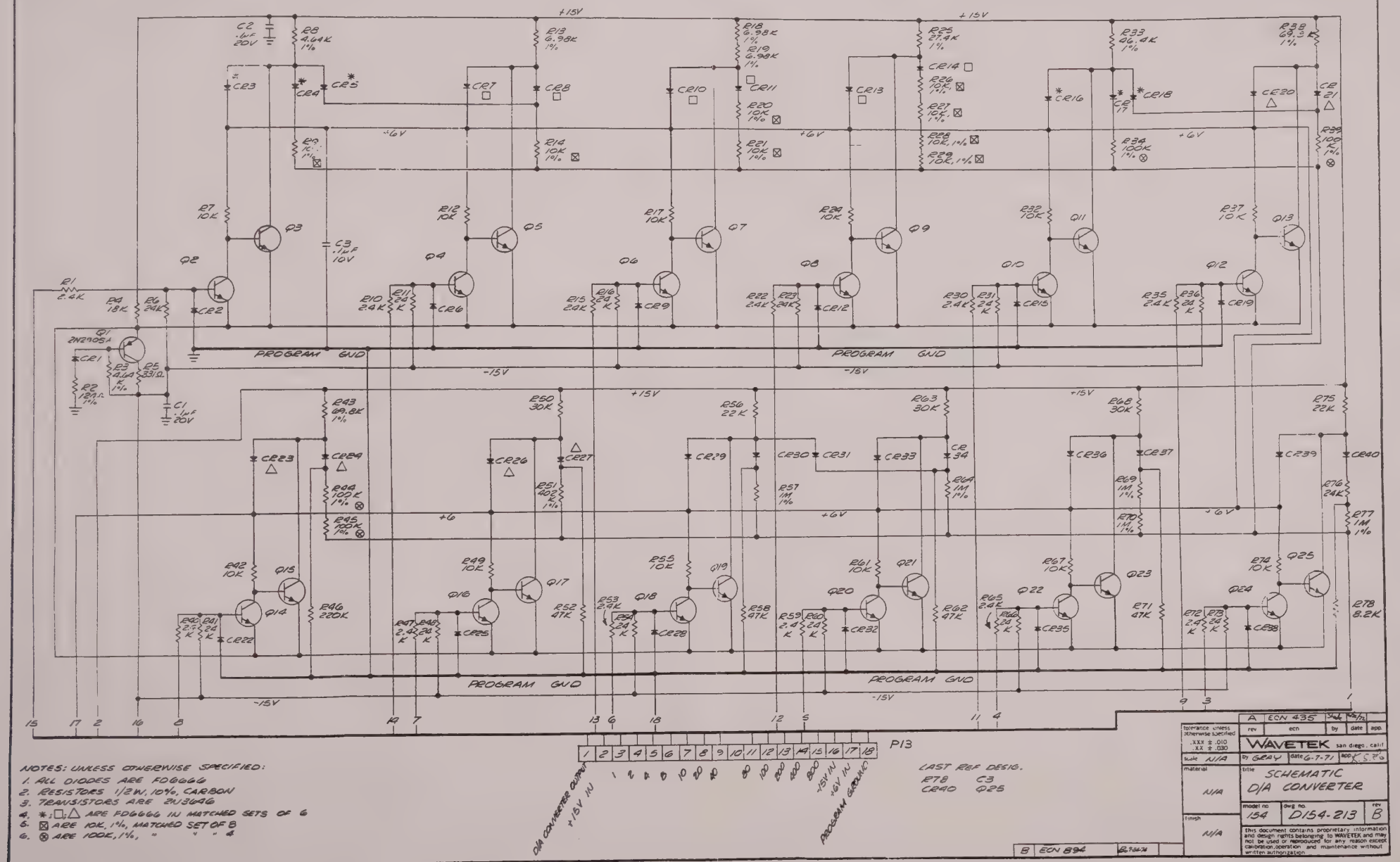
WAVETEK PARTS LIST	TITLE 6V POWER	ASSEMBLY NO. 1100-00-0089 PAGE: 1	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	UNIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R12 R25	RES,MF,1/8W,1%,2.87K	MN55D-2871F	TWA	4701-03-2871	2
R16 R26	RES,MF,1/8W,1%,38.3K	MN55D-3832F	TWA	4701-03-3832	2
R10 R19	RES,MF,1/8W,1%,3.92K	MN55D-3921F	TWA	4701-03-3921	2
R2	RES,MF,1/8W,1%,40K	MN55D-4002F	TWA	4701-03-4002	1
R1 R11 R24	RES,MF,1/8W,1%,4.75K	MN55D-4751F	TWA	4701-03-4751	3
R32 R9	RES,MF,1/8W,1%,8.99K	MN55D-8991F	TWA	4701-03-8991	2
R3	RES,MF,1/8W,1%,576	MN55D-5760F	TWA	4701-03-5760	1
R33	RES,MF,1/8W,1%,5.76K	MN55D-5761F	TWA	4701-03-5761	1
R14 R28	RES,MF,1/8W,1%,681	MN55D-6810F	TWA	4701-03-6810	2
R20	RES,MF,1/8W,1%,6.98K	MN55D-6981F	TWA	4701-03-6981	1
R8	RES,MF,1/8W,1%,7.5K	MN55D-7501F	TWA	4701-03-7501	1
R4	RES,MF,1/8W,1%,9.09K	MN55D-9091F	TWA	4701-03-9091	1
R22 R33	RES,MF,1/8W,1%,9.53K	MN55D-9531F	TWA	4701-03-9531	2
CR2 CR3	DIODE	1N4581	MICRO	4801-01-4581	2
CR1 CR4 CR5	DIODE	FD-6666	FAIR	4867-02-6666	3
Q1 Q2 Q3 Q4 Q5 Q6	TRANS	2N3644	FAIR	4901-03-4420	6
Q7 Q8 Q9	TRANS	2N4248	FAIR	4901-04-2480	3
IC1 IC2 IC3	IC,CLASS II,MA-709 ~~Q1741-7084-02-9486~~	130-501-14	WVTK	1700-00-0006	3

WAVETEK PARTS LIST	TITLE 6V POWER	ASSEMBLY NO 1100-00-0089 PAGE: 2	REV A

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE 6V, 23V POWER SUPPLY
FINISH: WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ± .030		
	DO NOT SCALE DWG	MODEL NO 154	DWG NO 1100-00-0089 REV A
	SCALE	COGE IDENT 23338	SHEET OF


+15V
-15V
+6V
PROGRAM GND
C2 .1uF 20V
R8 4.64K 1%
R13 6.98K 1%
R18 6.98K 1%
R19 6.98K 1%
R25 27.4K 1%
R33 66.4K 1%
R38 69.3K 1%
CR3
CR4
CR5
CR7
CR8
CR10
CR11
CR13
CR14
CR16
CR17
CR18
CR20
CR21
R9 1K 1%
R14 10K 1%
R20 10K 1%
R21 10K 1%
R26 10K, 1%
R27 10K, 1%
R28 10K, 1%
R29 10K, 1%
R34 100K 1%
R39 100K 1%
R7 10K
R12 10K
R17 10K
R24 10K
R32 10K
R37 10K
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
C3 .1uF 10V
R1 NN 2.4K
R4 18K
R6 24K
R10 2.4K
R11 24K
R15 2.4K
R16 24K
R22 2.4K
R23 24K
R30 2.4K
R31 24K
R35 2.4K
R36 24K
CR22
CR6
CR9
CR12
CR15
CR19
Q1 2N2905A
CR1
R3 4.64K 1%
R5 331Ω 1%
R2 121Ω 1%
C1 .1uF 20V
R43 69.8K 1%
R50 30K
R56 22K
R63 30K
R68 30K
R75 22K
CR23
CR24
CR26
CR27
CR29
CR30
CR31
CR33
CR34
CR36
CR37
CR39
CR40
R44 100K 1%
R45 100K 1%
R51 402Ω 1%
R57 1M 1%
R64 1M 1%
R69 1M 1%
R70 1M 1%
R76 24K
R77 1M 1%
R42 10K
R49 10K
R55 10K
R61 10K
R67 10K
R74 10K
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
R46 220K
R52 47K
R58 47K
R62 47K
R71 47K
R78 8.2K
R40 2.4K
R41 24K
R47 2.4K
R48 24K
R53 2.4K
R54 24K
R59 2.4K
R60 24K
R65 2.4K
R66 24K
R72 2.4K
R73 24K
CR22
CR25
CR28
CR32
CR35
CR38
P13
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
1 2 4 8 10 20 40 80 100 200 400 800 +15V IN +6V IN PROGRAM GROUND
D/A CONVERTER OUTPUT
+15V IN
LAST REF DESIG.
R78 C3
CR40 Q25
NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL DIODES ARE FD6666
2. RESISTORS 1/2W, 10%, CARBON
3. TRANSISTORS ARE 2N3646
4. *, □, △ ARE FD6666 IN MATCHED SETS OF 6
5. ☒ ARE 10K, 1%, MATCHED SET OF 8
6. ⊗ ARE 100K, 1%, " " " 4
A ECN 435
B ECN 894
WAVETEK san diego, calif
SCHEMATIC D/A CONVERTER
model no 154
dwg no D154-213
rev B
material N/A
finish N/A
scale N/A
by GRAY
date 6-7-71
tolerance unless otherwise specified .XXX ± .010 .XX ± .030
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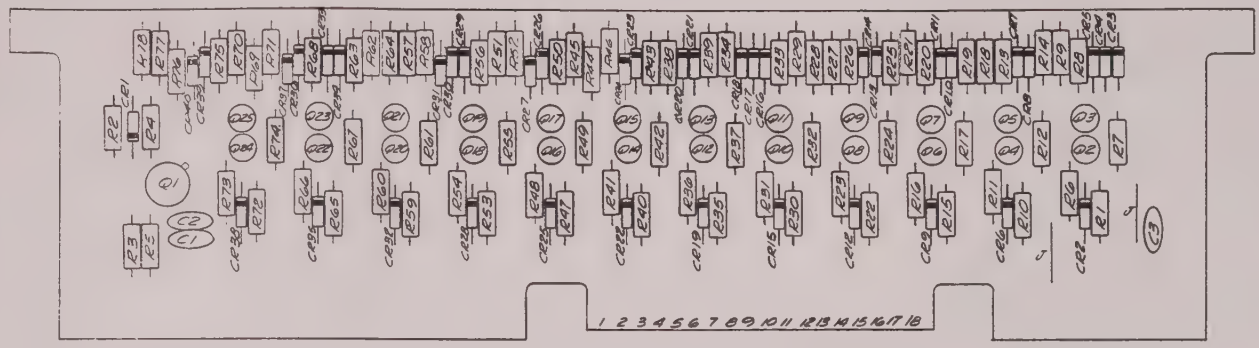

C	2735	WW	8/9/71	T. J.
B	ECN 896		8-24-76	
A	ECN 476		6-7-72	
rev	ecn		by	date	app

tolerance unless otherwise specified
XXX ± 010
.XX ± 030

WAVETEK san diego, calif

scale 2/1 | by GRAY | date 6-11-71 | app K. S. K.

material N/A

title ASSEMBLY, D-A CONVERTER

finish N/A

model no 154 | dwg no 0101-00-0083 | rev C

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DWG,D-A CONV	0101-00-0083	WVTK	0101-00-0083	1
NONE	SCHEMATIC,D-A CONV	0103-00-0083	WVTK	0103-00-0083	1
C3	CAP,CER,.1MF,10V	UK10-104	AMCO	1500-01-0813	1
C1 C2	CAP,CER,.1MF,20V	UK20-104	AMCO	1500-01-0813	2
NONE	D-A CONV	154-113	WVTK	1700-00-0083	1
NONE	TRANS,MAU	101C3A	METHS	2800-11-0003	1
R12 R17 R24 R32 R37 R42 R49 R55 R61 R67 R74	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	12
R2	RES,MF,1/8W,1%,124	RN55D-1240F	TRW	4701-03-1240	1
R4	RES,MF,1/8W,1%,18.2K	RN55D-1822F	TRW	4701-03-1822	1
R56 R75	RES,MF,1/8W,1%,21.5K	RN55D-2152F	TRW	4701-03-2152	2
R40	RES,MF,1/8W,1%,221K	RN55D-2213F	TRW	4701-03-2213	1
R1 R10 R15 R22 R30 R35 R40 R47 R55 R59 R65 R76	RES,MF,1/8W,1%,2.37K	RN55D-2371F	TRW	4701-03-2371	12
R11 R16 R23 R31 R36 R41 R48 R54 R60 R66 R66 R73 R78	RES,MF,1/8W,1%,23.7K	RN55D-2372F	TRW	4701-03-2372	13
R25	RES,MF,1/8W,1%,27.4K	RN55D-2742F	TRW	4701-03-2742	1
R50 R63 R68	RES,MF,1/8W,1%,30.1K	RN55D-3012F	TRW	4701-03-3012	3

WAVETEK PARTS LIST | TITLE D-A CONVERTER | ASSEMBLY NO. 1100-00-0083 | PAGE: 1 | REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R33	RES,MF,1/8W,1%,88.7K	RN55D-8872F	TRW	4701-03-8872	1
R3 R8	RES,MF,1/8W,1%,4.75K	RN55D-4751F	TRW	4701-03-4751	2
R52 R58 R62 M71	RES,MF,1/8W,1%,47.5K	RN55D-4752F	TRW	4701-03-4752	4
R13 R18 R19	RES,MF,1/8W,1%,6.98K	RN55C-6981F	TRW	4701-03-6981	3
R38 M43	RES,MF,1/8W,1%,69.8K	RN55D-6982F	TRW	4701-03-6982	2
R76	RES,MF,1/8W,1%,8.25K	RN55D-8251F	TRW	4701-03-8251	1
M57 M66 M69 M70 M77	RES,MF,1/8W,1%,1M	RN60D-1004F	TRW	4701-13-1004	5
M5	RES,MF,1/8W,1%,332	RN60D-3320F	TRW	4701-13-3320	1
M51	RES,MF,1/8W,1%,402K	RN60D-4023F	TRW	4701-13-4023	1
M14 R20 M21 R26 M27 R28 M29 M9	RES,SET,8-10K,1/8W WITH M47U1-03-1002	134-500-87	WVTK	4784-00-0020	1
M34 R39 R44 M45	RES,SET,4-100K,1/8W WITH M4701-03-1003	134-500-96	WVTK	4789-00-0027	1
CR1 CR12 CR15 CR19 CR2 CR22 CR25 CR28 CR29 CR30 CR31 CR32 CR33 CR34 CR35 CR36 CR37 CR38 CR39 CR40 CR6 CR9	DIODE	FD-0000	FAIR	4807-02-0006	22
CR10 CR11 CR13 CR18 CR16 CR17 CR10 CR20 CR21 CR23 CR24 CR26 CR27 CR3 CR4 CR5 CR7 CR8	DIODE,SET,8-HD-0000 WITH M4807-02-0000	134-500-84	WVTK	4898-00-0001	3

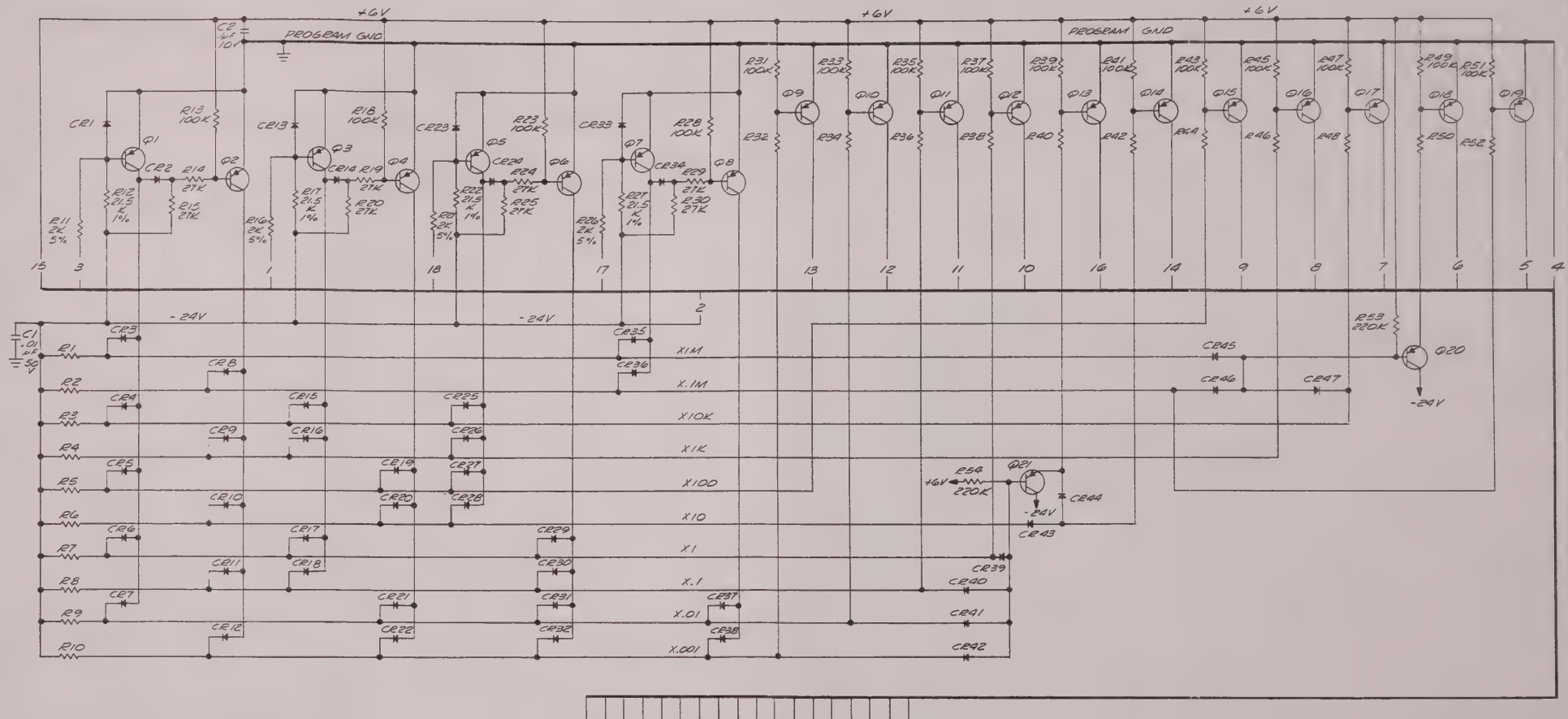
WAVETEK PARTS LIST | TITLE D-A CONVERTER | ASSEMBLY NO. 1100-00-0083 | PAGE: 2 | REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U1	TRANS	2N2905	FAIR	4901-02-9051	1
Q10 U11 U12 U13 U14 U15 U16 U17 U18 U19 U2 U20 U21 U22 U23 U24 U25 U3 U4 U5 U6 U7 U8 U9	TRANS	2N3646	FAIR	4901-03-0060	24

WAVETEK PARTS LIST | TITLE D-A CONVERTER | ASSEMBLY NO. 1100-00-0083 | PAGE: 3 | REV B

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: D-A CONVERTER
	RELEASE APPROV		
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ±.010 ANGLES ±1°, XX ±.020		MODEL NO. 154
	DO NOT SCALE DWG		DWG NO. 1100-00-0083
	SCALE		REV B
			CODE IDENT 23338
			SHEET OF



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/8W, 1% CARBON
2. ALL RESISTORS ARE 33K
3. ALL TRANSISTORS ARE 2N3638A
4. ALL DIODES ARE FD6666

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

P14

2 -24V IN
1 PROGRAM GND
X1M CONTROL OUTPUT
X.1M CONTROL OUTPUT
X10K CONTROL OUTPUT
X1K CONTROL OUTPUT
X100 CONTROL OUTPUT
X1 CONTROL OUTPUT
X.1 CONTROL OUTPUT
X.01 CONTROL OUTPUT
X.001 CONTROL OUTPUT
X.0 CONTROL OUTPUT
+6V IN
CAPACITANCE MULTIPLIER CONTROL
3
4

LAST REF DESIG
R54
CR47
Q21
C2

C	ECN 1867	B.S.214	11/21/75
B	ECN 1599	JD	7/24/73
A	ECN 935	WL	7/24/73

tolerance unless otherwise specified .XX ± .010 .X ± .05		WAVETEK san diego, calif.	
finish N/A	drawn GRAY	date 6-9-71	400 K S-O
material N/A	title SCHEMATIC, FREQUENCY RANGING		
model no. 154	dwg no. 0103-00-0082		rev C
next assy N/A			

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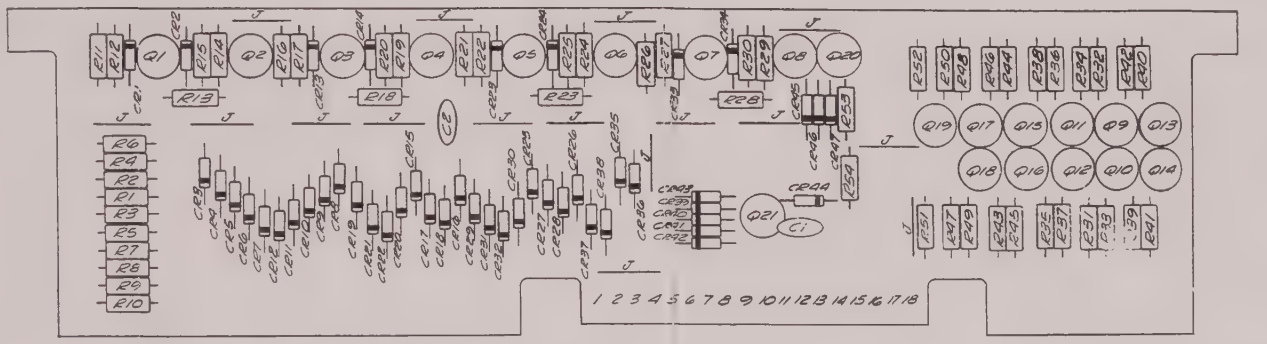

	A	ECN 1857	DVB	7-5-78	
	rev	ecn	by	date	appd
	WAVETEK san diego, calif				
size 211	dr GRAY	date 6-16-77	appd K.S.		
proj N/A	title ASSEMBLY FREQ RANGING				
mfg N/A	model no 154	dwg no 0101-00-0082		rev A	

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG,MATRIX	0101-00-0082	WVTK	0101-00-0082	1
NONE	SCHEMATIC,MATRIX	0103-00-0082	WVTK	0103-00-0082	1
C1	CAP,CER,.01MF,50V	DA-103	CHL	1500-01-0310	1
C2	CAP,CER,.1MF,10V	DA10-104	CHL	1500-01-0412	1
NONE	RANGE MATRIX	150-112	WVTK	1700-00-0062	1
NONE	TRANSIPAD	10123K	WFTAS	2000-11-0003	21
R13 R16 R23 R28 R51 R33 R35 R37 R39 R41 R43 R45 R47 R49 R51	RES,MF,1/8W,1%,100K	RN55D-1003F	TRW	0701-03-1003	15
R11 R16 R21 R26	RES,MF,1/8W,1%,2K	RN55D-2001F	TRW	0701-03-2001	4
W12 R17 R22 R27	RES,MF,1/8W,1%,21.5K	RN55D-2152F	TRW	0701-03-2152	4
R53 R56	RES,MF,1/8W,1%,221K	RN55D-2213F	TRW	0701-03-2213	2
R14 R15 W19 W20 W24 R25 R29 W30	RES,MF,1/8W,1%,27.4K	RN55D-2742F	TRW	0701-03-2742	8
R1 W10 W2 R3 R12 W34 R36 W38 W4 R40 R42 W44 W46 W5 R50 R52 R6 W7 W8 W9	RES,MF,1/8W,1%,33.2K	RN55D-3322F	TRW	0701-03-3322	21
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR2 CR20 CR21 CR22 CR23	DIODE	FD-0000	FAIR	WR07-02-0000	47

WAVETEK PARTS LIST

TITLE: RANGE MATRIX

ASSEMBLY NO.: 1100-00-0082

PAGE: 1

REV: A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
CR26 CR25 CR20 CR27 CR24 CR29 CR5 CR30 CR31 CR32 CR33 CR34 CR35 CR36 CR37 CR38 CR39 CR4 CR40 CR41 CR42 CR43 CR44 CR45 CR46 CR47 CR5 CR6 CR7 CR8 CR9					
Q1 Q10 Q11 Q12 W13 Q14 Q15 W16 Q17 W18 Q19 Q2 W20 Q21 Q3 W4 W5 Q6 Q7 W8 W9	1N485	2N5484	CAMTW	0401-03-2481	21

WAVETEK PARTS LIST

TITLE: RANGE MATRIX

ASSEMBLY NO.: 1100-00-0082

PAGE: 2

REV: A

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL

FINISH WAVETEK PROCESS

DRAWN

DATE

PROJENGR

RELEASE APPROV

TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030

DO NOT SCALE DWG

SCALE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: FREQUENCY RANGING

MODEL NO.: 154

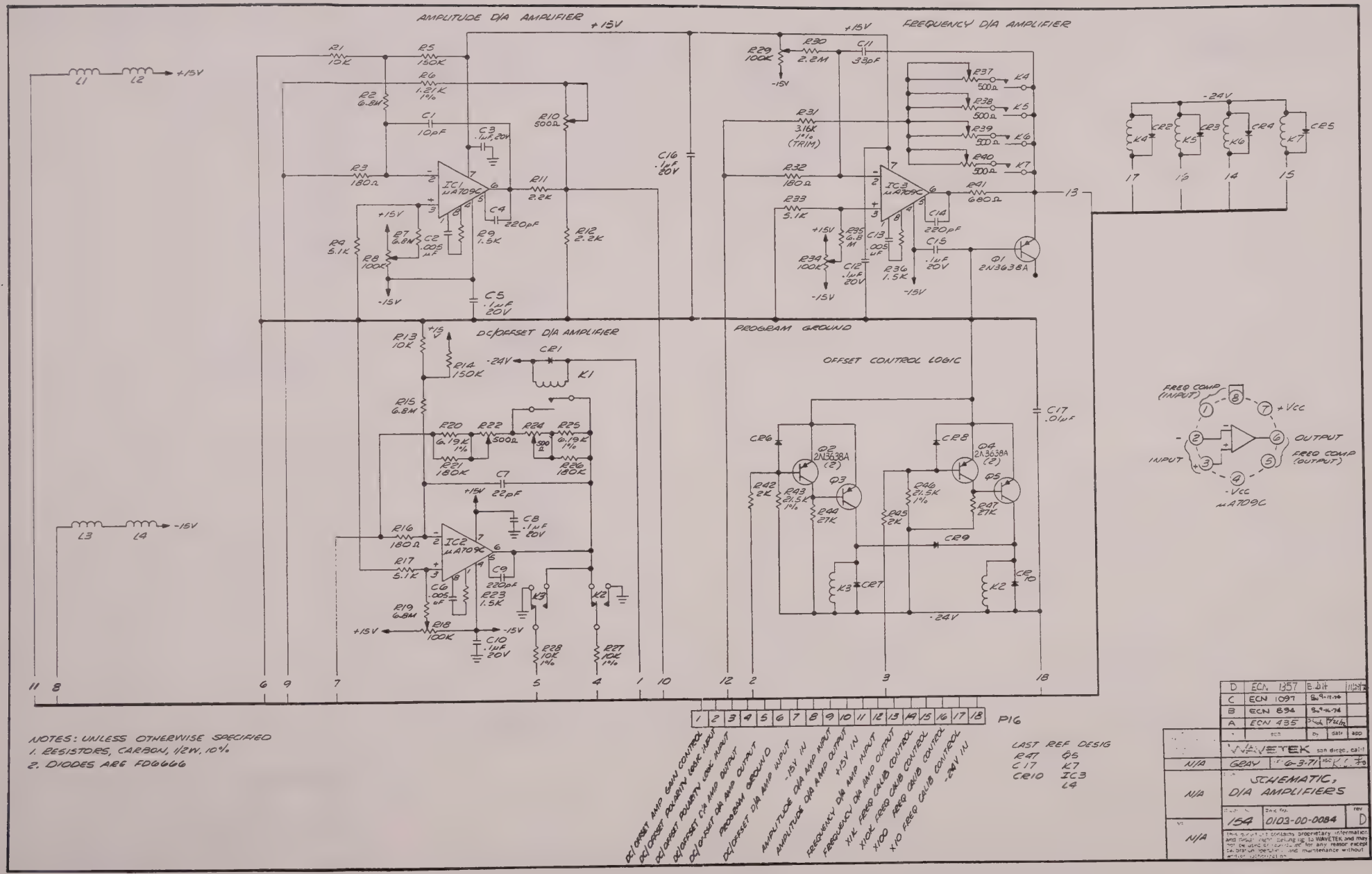
DWG NO.: 1100-00-0082

REV: A

CODE IDENT: 23338

SHEET OF

NOTE: UNLESS OTHERWISE SPECIFIED



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS, CARBON, 1/2W, 10%
2. DIODES ARE FD6666

D	ECN 1357	B Dit	11/24/72
C	ECN 1097	B 9-12-72	
B	ECN 834	B 9-6-72	
A	ECN 435	Dick Fuller	
	eco	by date	app

WAVETEK san diego, calif

N/A	GRAY	6-3-71	
N/A	SCHEMATIC, D/A AMPLIFIERS		
	154	0103-00-0084	D
N/A			

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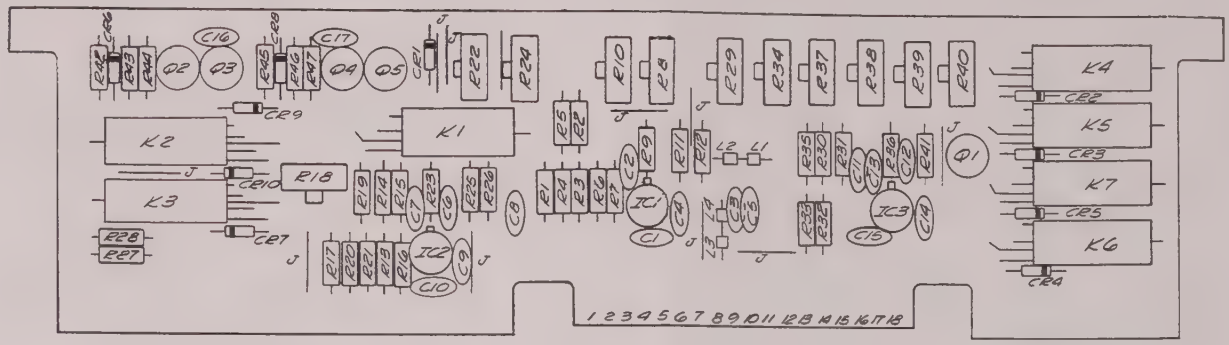

B	ECN 1957	RVB 12-5-78		
A	ECN 594	RVB 9-8-76		
rev	ecn	by	date	app

unless otherwise specified: XXX ± .010, XX ± .030, ∠ ± 2°

WAVETEK san diego, calif.

drawn by GRAY date 6-15-77 approved

material: N/A

finish: N/A

title: ASSEMBLY D-A AMPLIFIER

model no.	dwg no.	rev
154	0101-00-0084	B

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
NONE	ASSY DWG,AMPLIFIER	0101-00-0084	WVTK	0101-00-0084	1
NONE	SCHEMATIC,D-A AMP	0103-00-0084	WVTK	0103-00-0084	1
C1	CAP,CER,10PF,1KV	DD-100	CRL	1500-01-0011	1
C17	CAP,CER,.01MF,50V	CK-103	CML	1500-01-0310	1
C10 C12 C15 C16 C3 C5 C8	CAP,CER,.1MF,20V	UK20-104	CML	1500-01-0413	7
C7	CAP,CER,22PF,1KV	DD-220	AMCO	1500-02-2011	1
C14 C4 C9	CAP,CER,220PF,1KV	DD-221	AMCO	1500-02-2111	3
C11	CAP,CER,33PF,1KV	DD-330	AMCO	1500-03-3011	1
C13 C2 C6	CAP,CER,.005MF,50V	CK-502	CML	1500-05-0210	3
NONE	D-A AMP	154-114	WVTK	1700-00-0084	1
NONE	TRANSIPAD	10123A	METWS	2800-11-0003	5
L1 L2 L3 L4	FERRITE BEAD	56-590-65/3B	FERRI	3100-00-0001	4
K1 K4 K5 K6 K7	RELAY,REED,FORM=A	PS-804	PHIPP	4500-00-0004	5
K2 K3	RELAY,REED,FORM=C	PS-805	PHIPP	4500-00-0005	2
R19 R29 R34 R8	POT,TRIM,100K	91A-100K	BECK	4600-01-0002	4
R10 R22 R24 R37 R38 R39 R40	POT,TRIM,500	91A-500	BECK	4600-05-0100	7
R30	RES,C,1/2W,10%,2.2M	RC20GF-225	STKPL	4700-25-2204	1

WAVETEK PARTS LIST — TITLE: D-A AMPLIFIER — ASSEMBLY NO. 1100-00-0084 — PAGE: 1 — REV: B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
R15 R19 R2 R35 R7	RES,C,1/2W,10Ω,0.8M	RC20GF-805	STKPL	4700-25-8P08	5
R1 R13 R27 R28	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	4
R6	RES,MF,1/8W,1%,1.21K	RN55D-1211F	TRW	4701-03-1211	1
R23 R36 R9	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	3
R14 R5	RES,MF,1/8W,1%,150K	RN55D-1503F	TRW	4701-03-1503	2
R21 R26	RES,MF,1/8W,1%,178K	RN55D-1783F	TRW	4701-03-1783	2
R16 R3 R32	RES,MF,1/8W,1%,200	RN55D-2000F	TRW	4701-03-2000	3
R42 R45	RES,MF,1/8W,1%,2K	RN55D-2001F	TRW	4701-03-2001	2
R43 R46	RES,MF,1/8W,1%,21.5K	RN55D-2152F	TRW	4701-03-2152	2
R11 R12	RES,MF,1/8W,1%,2.21K	RN55D-2211F	TRW	4701-03-2211	2
R44 R47	RES,MF,1/8W,1%,27.4K	RN55D-2742F	TRW	4701-03-2742	2
R31T	RES,MF,1/8W,1%,3.16K	RN55D-3161F	TRW	4701-03-3161	1
R17 R33 R4	RES,MF,1/8W,1%,4.99K	RN55D-4991F	TRW	4701-03-4991	3
R20 R25	RES,MF,1/8W,1%,6.19K	RN55D-6191F	TRW	4701-03-6191	2
R41	RES,MF,1/8W,1%,681	RN55D-6810F	TRW	4701-03-6810	1
CR1 CR10 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE	FD-6060	FAIR	4807-02-0006	10
Q1 Q2 Q3 Q4 Q5	TRANS	2N3638A	CENTH	4901-03-6381	5

WAVETEK PARTS LIST — TITLE: D-A AMPLIFIER — ASSEMBLY NO. 1100-00-0084 — PAGE: 2 — REV: B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
IC1 IC2 IC3	IC,CLASS 1,HA-700 QTY:1:7009-07-0900	150-501-13	WVTK	7200-00-0005	3

WAVETEK PARTS LIST — TITLE: D-A AMPLIFIER — ASSEMBLY NO. 1100-00-0084 — PAGE: 3 — REV: B

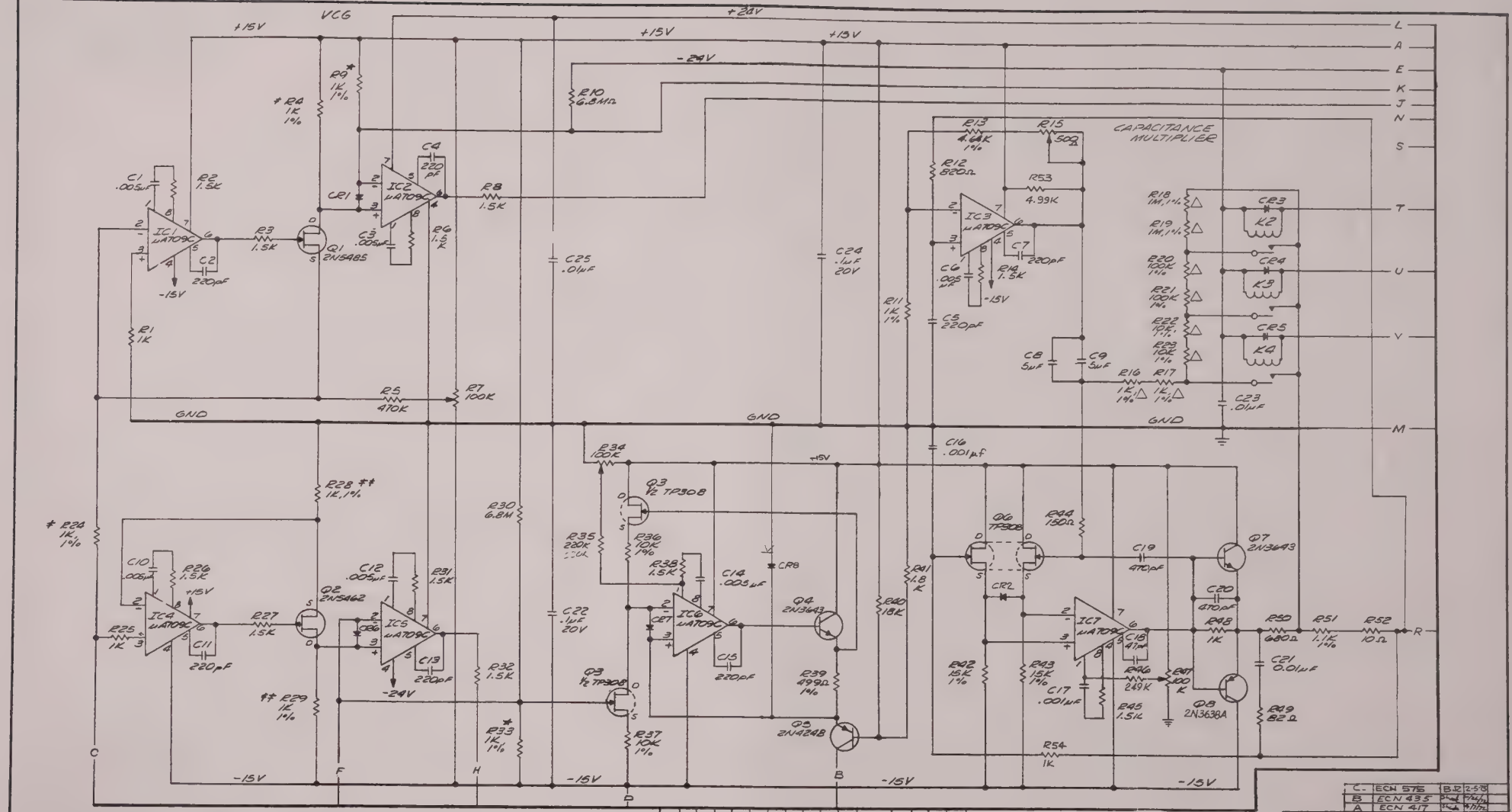
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH: WAVETEK PROCESS
DRAWN | DATE
PROJENGR
RELEASE APPROV
TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ± .010 ANGLES ± 1° .XX ± .030
DO NOT SCALE DWG
SCALE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: D-A AMPLIFIER

MODEL NO: 154 | DWG NO: 1100-00-0084 | REV: B
CODE IDENT NO: 23338 | SHEET | OF



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE 1/8W, 1%, CARBON
2. * INDICATES MATCHED PAIR
3. ** INDICATES MATCHED PAIR
4 ** " " "
5 △ " " SET

LAST REF DES.
R54 Q8
C25 IC7
CR8 K4

J	2585			F	ECN 1509		
H	ECN 1857			E	ECN 1096		
G	ECN 1599			D	ECN 896		
				C	ECN 575	B.R.	2-5-73
				B	ECN 435		
				A	ECN 417		

tolerance unless otherwise specified: .XXX ± .010, .XX ± .030
material: N/A
finish: N/A
scale: N/A
drawn by: GRAY, date: 6-23-71, approved: K.S.F.
WAVETEK san diego, calif
title: SCHEMATIC, VCG BOARD
model no.: 134
dwg no.: 0103-00-00B6
rev: F

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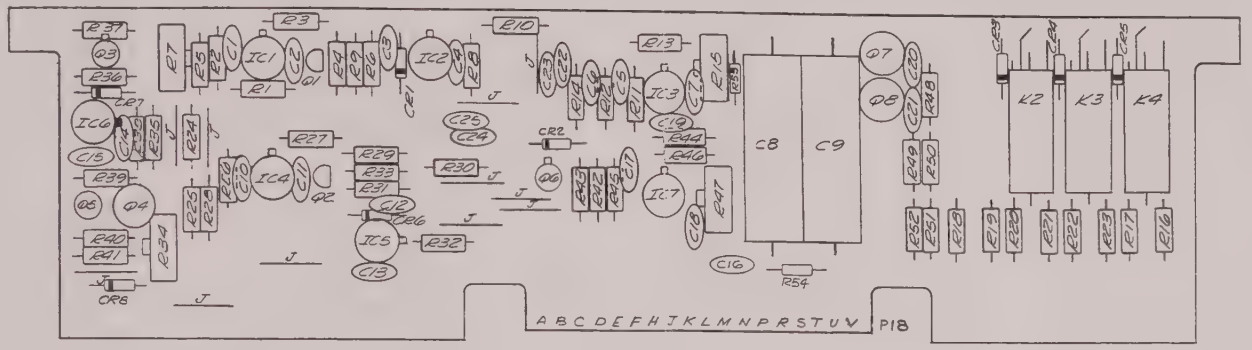

F	ECN 1857	DVB 12-5-8	
E	ECN 1509	EO 2377	
D	ECN 834	BW 9-16-76	
C	ECN 1094	BW 9-16-74	
B	ECN 575	B.R. 7-6-73	
A	ECN 435	[illegible] 9/24/72	
rev	ecn	by	date	app.

tolerance unless otherwise specified
.xxx ± .010
.xx ± .030

WAVETEK san diego, calif

scale 2/1 | dr GRAY | date 8-23-77 | app K. S.

material N/A

title ASSEMBLY, VCG BOARD

finish N/A

model no. 154 | dwg no 0101-00-0086 | rev F

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG,VCG	0101-00-0086	WVTK	0101-00-0086	1
NONE	SCHEMATIC,VCG	0103-00-0086	WVTK	0103-00-0086	1
C16 C17	CAP,CER,.001MF,1KV	DU-102	AMCO	1500-01-0211	2
C21 C23 C25	CAP,CER,.01MF,50V	CK-103	CML	1500-01-0310	3
C22 C24	CAP,CER,.1MF,20V	UK20-104	CML	1500-01-0413	2
C11 C13 C15 C2 C4 C5 C7	CAP,CER,220PF,1KV	DD-221	AMCO	1500-02-2131	7
C18	CAP,CER,.47PF,1KV	DD-470	AMCO	1500-04-7011	1
C19 C20	CAP,CER,.470PF,1KV	DD-471	AMCO	1500-04-7111	2
C1 C10 C12 C14 C3 L6	CAP,CER,.005MF,50V	CK-502	CML	1500-05-0210	6
C8 C9	CAP,POLYC,.5MF,100V	C1A505F	ELMEC	1500-45-2504	2
BAT	VCG	150-116	WVTK	1700-00-0086	1
K2 K3 K4	RELAY,REED,FORM-A	PS-804	PMIPP	4500-00-0004	3
R54 R47 R7	POT,TRIM,100K	91A1100A	BECK	4000-01-0402	3
R15	POT,TRIM,500	91A1500	BECK	4005-05-0104	1
R10 R30	RES,C,1/2W,10%,0.8M	MC20GF-805	STACK	4700-25-0804	2
R1 R11 R25 R48 R54	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	5
R36 R37	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	2

WAVETEK PARTS LIST | TITLE V-C-G | ASSEMBLY NO 1100-00-0086 | PAGE: 1 | REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	RES,MF,MIXED SET	142-501-50	WVTK	0784-06-0033	1
R16 R17	RES,MF,1/8W,1%,1K PART OF 0784-00-0033 QTY(2)				
R18 R19	RES,MF,1/8W,1%,1K PART OF 0784-06-0033 QTY(2)				
R20 R21	RES,MF,1/8W,1%,100K PART OF 0784-00-0033 QTY(2)				
R22 R23	RES,MF,1/8W,1%,10K PART OF 0784-00-0033 QTY(2)				
	DIODE	FL-4000	[illegible]	[illegible]	4
	TRANS	2N3904	[illegible]	[illegible]	1
	TRANS	2N3643	[illegible]	4401-01-0435	2
	TRANS	2N2484	[illegible]	4401-06-2040	1
	TRANS	2N3646	[illegible]	[illegible]	1
	TRANS	TP-3/4	[illegible]	4402-70-0300	2
	TRANS,DPL,2N5962 QTY:1:4401-05-0262	142-501-54	[illegible]	[illegible]	1
	IC,CLASS I,MZ-704	140-4401-15	[illegible]	7200-06-0004	1

WAVETEK PARTS LIST | TITLE V-C-G | ASSEMBLY NO 1100-00-0086 | PAGE: 3 | REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R52	RES,MF,1/8W,1%,10	RN55D-10R0F	TRW	4701-03-1000	1
R51	RES,MF,1/8W,1%,1.1K	RN55D-1101F	TRW	4701-03-1101	1
R46	RES,MF,1/8W,1%,150	RN55D-150RF	TRW	4701-03-150R	1
R14 R2 R26 R27 R3 R31 R32 R38 R45 R6 R8	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	11
R42 R43	RES,MF,1/8W,1%,15K	RN55D-1502F	TRW	4701-03-1502	2
R41	RES,MF,1/8W,1%,1.78K	RN55D-1781F	TRW	4701-03-1781	1
R40	RES,MF,1/8W,1%,18.2K	RN55D-1822F	TRW	4701-03-1822	1
R35	RES,MF,1/8W,1%,221K	RN55D-2213F	TRW	4701-03-2213	1
R13	RES,MF,1/8W,1%,8.06K	RN55D-8061F	TRW	4701-03-8061	1
R39	RES,MF,1/8,1%,499	RN55D-4990F	TRW	4701-03-4990	1
R53	RES,MF,1/8W,1%,4.99K	RN55D-4991F	TRW	4701-03-4991	1
R50	RES,MF,1/8W,1%,681	RN55D-6810F	TRW	4701-03-6810	1
R12	RES,MF,1/8W,1%,825	RN55D-8250F	TRW	4701-03-8250	1
R49	RES,MF,1/8W,1%,82.5	RN55D-82R5F	TRW	4701-03-8259	1
R44 R5	RES,MF,1/8W,1%,499K	RN60D-4993F	TRW	4701-13-4993	2
R24 R28 R29 R33 R4 R9	RES,SET,2-1K,1/4W QTY:2:4701-03-1001	142-501-49	WVTK	4789-00-0006	3

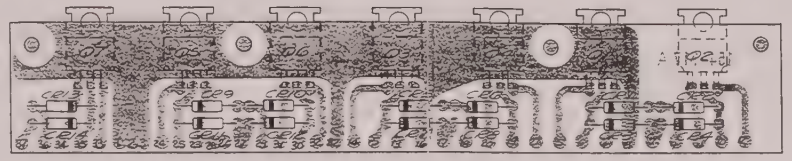
WAVETEK PARTS LIST | TITLE V-C-G | ASSEMBLY NO. 1100-00-0086 | PAGE: 2 | REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	QTY:1:7800-07-0000				

WAVETEK PARTS LIST | TITLE V-C-G | ASSEMBLY NO 1100-00-0086 | PAGE: 4 | REV F

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: VCG BOARD
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030		MODEL NO 159 / DWG NO 1100-00-0086 / REV F
	DO NOT SCALE DWG		CODE IDENT NO 23338 / SHEET OF
	SCALE		

NOTE: UNLESS OTHERWISE SPECIFIED



PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1		DIODES			
2	CR1-CR14	SCE-1	SEMITECH		14
3					
4					
5		TRANSISTORS			
6	Q1, Q3, Q5, Q7	TIP 29	TEXAS INSTRUMENT	TIP 29	4
7	Q2 Q4 Q6	TIP 30		TIP 30	3
8					
9					
10		CIRCUIT BOARD	WAVETEK	154-117A	1
11					
12					
13					

NOTES: UNLESS OTHERWISE SPECIFIED
1. TRANSISTORS MOUNTED ON CIRCUIT SIDE

tolerance unless otherwise specified	rev	ecn	by	date	app.
.XXX ± .010 .XX ± .030	WAVETEK san diego, calif				
scale 2/1	DT GRAY	date 6-30-78	app'd K.S.F.		
material N/A	title ASSEMBLY, TRANSISTOR MOUNTING BD				
	model no. 154	dwg no. 0154-017		rev	
finish N/A	this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization				

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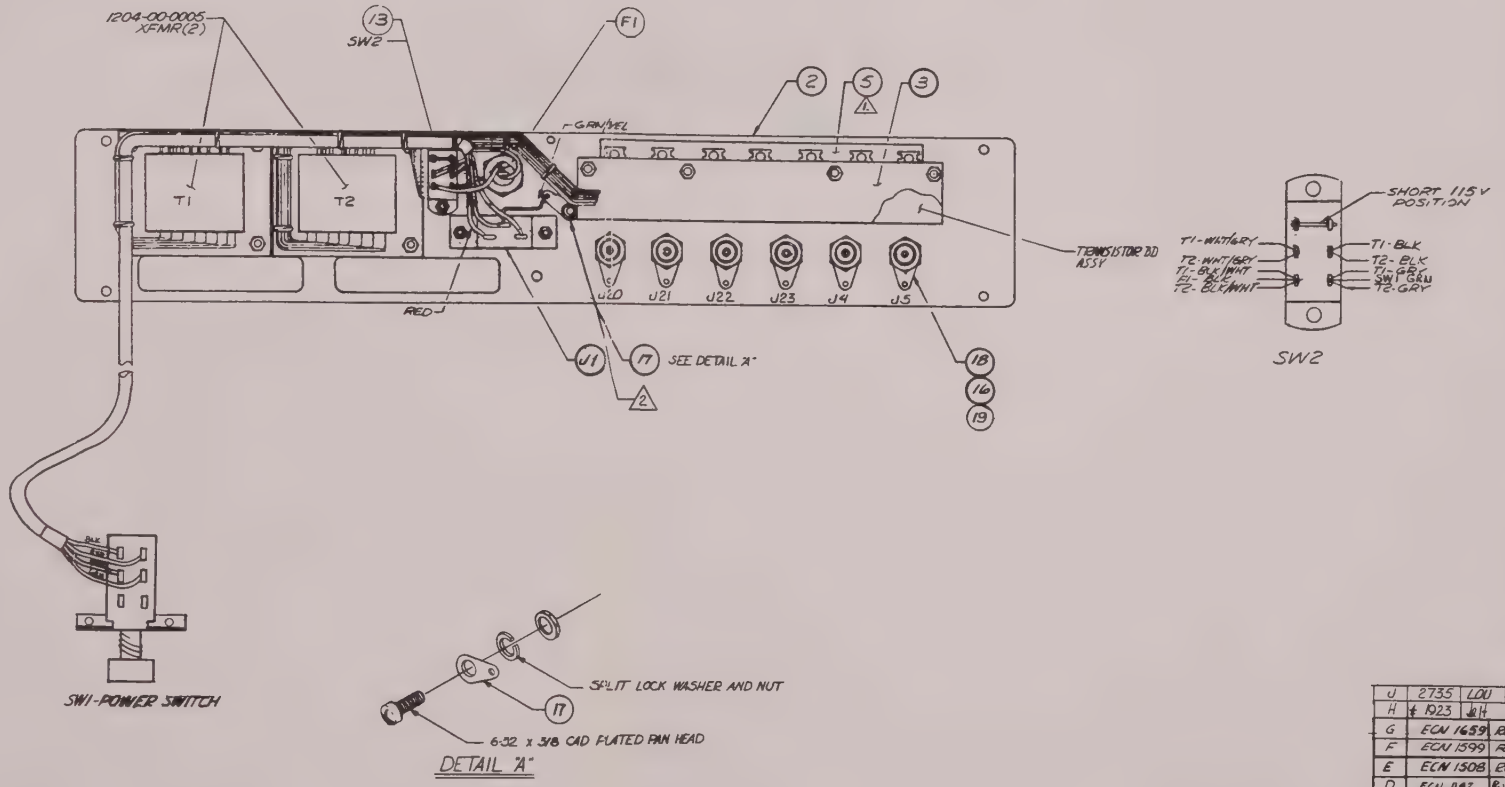
REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	TRANS MOUNTING	154-117	WVTK	1700-00-0087	1
CR1 CR10 CR11 CR12 CR13 CR14 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE	SCE-1	SEMTC	8801-02-0001	14
Q1 Q3 Q5 Q7	TRANS	TIP-29	TI	4902-00-0290	4
Q2 Q4 Q6	TRANS	TIP-30	TI	4902-00-0300	3

WAVETEK PARTS LIST	TITLE XISTR MTG BD	ASSEMBLY NO 1100-30-0087 PAGE: 1	REV

NOTE UNLESS ' 'RWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE TRANSISTOR MOUNTING BOARD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX : 010 ANGLES : ° XX : 030		
	DO NOT SCALE DWG		MODEL NO 154 DWG NO 1100-00-0087 REV
	SCALE		CODE IDENT 23338 SHEET OF



NOTES:
1. APPLY THERMAL COMPOUND TO ITEM 5 (BETWEEN REAR PANEL AND INSULATOR)
2. ALL CONNECTORS TO BE MECHANICALLY SECURE TO CHASSIS PRIOR TO SOLDERING GROUND WIRES TO LUGS.

J	2735	LOU	6-9-81
H	# 1923	JH	7-8-79
G	ECN 1659	RD	3-3-78
F	ECN 1599	RD	9-23-77
E	ECN 1508	RD	2-3-77
D	ECN 1142	RJ	7-21-76
C	ECN 1102	BL	4-21-76
B	485	BL	2-2-76
A	401	BL	12-2-75
rev	eco	by	date

WAVETEK san diego, calif.

tolerances unless otherwise specified	.XXX ± .010 .XX ± .030
scale N/A	
material N/A	
finish N/A	
drawn by Bookout	date 8-17-77
title	REAR PANEL ASSY
model no.	154
dwg no.	0102-00-0331
rev	J

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. REAR PANEL	0102-00-0331	WVTK	0102-00-0331	1
T1 T2	TRANSFORMER	142-500	WVTK	1204-00-0005	2
NONE	END BELL	110-333	WVTK	1400-00-0174	2
2	PANEL, REAR	154-302	WVTK	1400-00-2830	1
3	SUPT. BD	154-312	WVTK	1400-00-2900	1
5	INSULATOR	154-314	WVTK	1400-00-2910	1
NONE	I.D. LABEL	1400-00-9100	WVTK	1400-00-9100	1
J20 J21 J22 J23 J4 J5	BNC CONN	KC-7946	KING	2100-01-0002	6
J1	RECEPT. POWER	EAC-301	SMCFT	2100-03-0005	1
18	SOLDER LUG	1497	SMITH	2100-04-0012	6
17	SOLDER LUG	1485-6	SMITH	2100-04-0025	1
F1	FUSE, 1/2A, 250V	313.500	LITFU	2400-05-0010	1
10	FUSE HOLD	031.1633/031.1666	SCHUR	2400-05-0012	1
19	WASHER, SHOULDER	2668	SMITH	2800-27-0004	6
16	NYLON FLAT WASHER	2264-N-385	AMTOM	2800-28-0005	6
	SWITCH ASSY SLIDE	46256-LF	SMCFT	5105-00-0002	1
13	SOLDER GUARD	46256-LF-SG	SMCFT	5105-09-0001	1

WAVETEK PARTS LIST

TITLE: REAR PANEL ASSY

ASSEMBLY NO.: 1101-00-0072

PAGE: 1

REV: G

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL

FINISH WAVETEK PROCESS

DRAWN | DATE

PROJ ENGR

RELEASE APPROV

TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030

DO NOT SCALE DWG

SCALE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: REAR PANEL

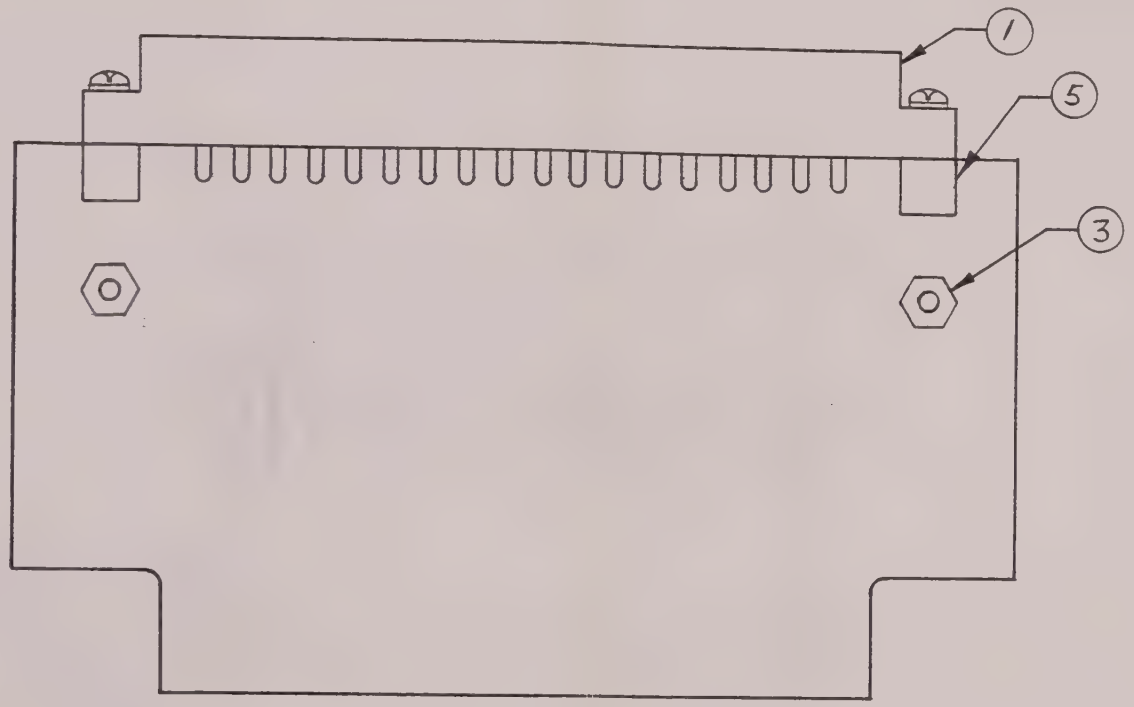
MODEL NO: 154

DWG NO: 1101-00-0072

REV: G

CODE IDENT: 23338

SHEET 1 OF 1



PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1		CONNECTOR	CINCH	252-18-30-160	1
2					
3		STANDOFF	USECO	1531-B 3/8	2
4					
5		CHASSIS BLOCK	USECO	1591-B 11	2
6					
7					
8		P.C. BOARD	WAVETEK	154-118A	1
9					

TOLERANCE UNLESS OTHERWISE SPEC: XXX .010, XX .030, ANGLES 0.36	REV	ECN	BY	DATE	APP
SCALE 2/1	WAVETEK SAN DIEGO CALIF				
MATERIAL N/A	BY GRAY DATE 10-25-71 APP				
FINISH N/A	TITLE A554 EXTENDER BD				
	MODEL NO 154	DRG NO 154-018	REV		

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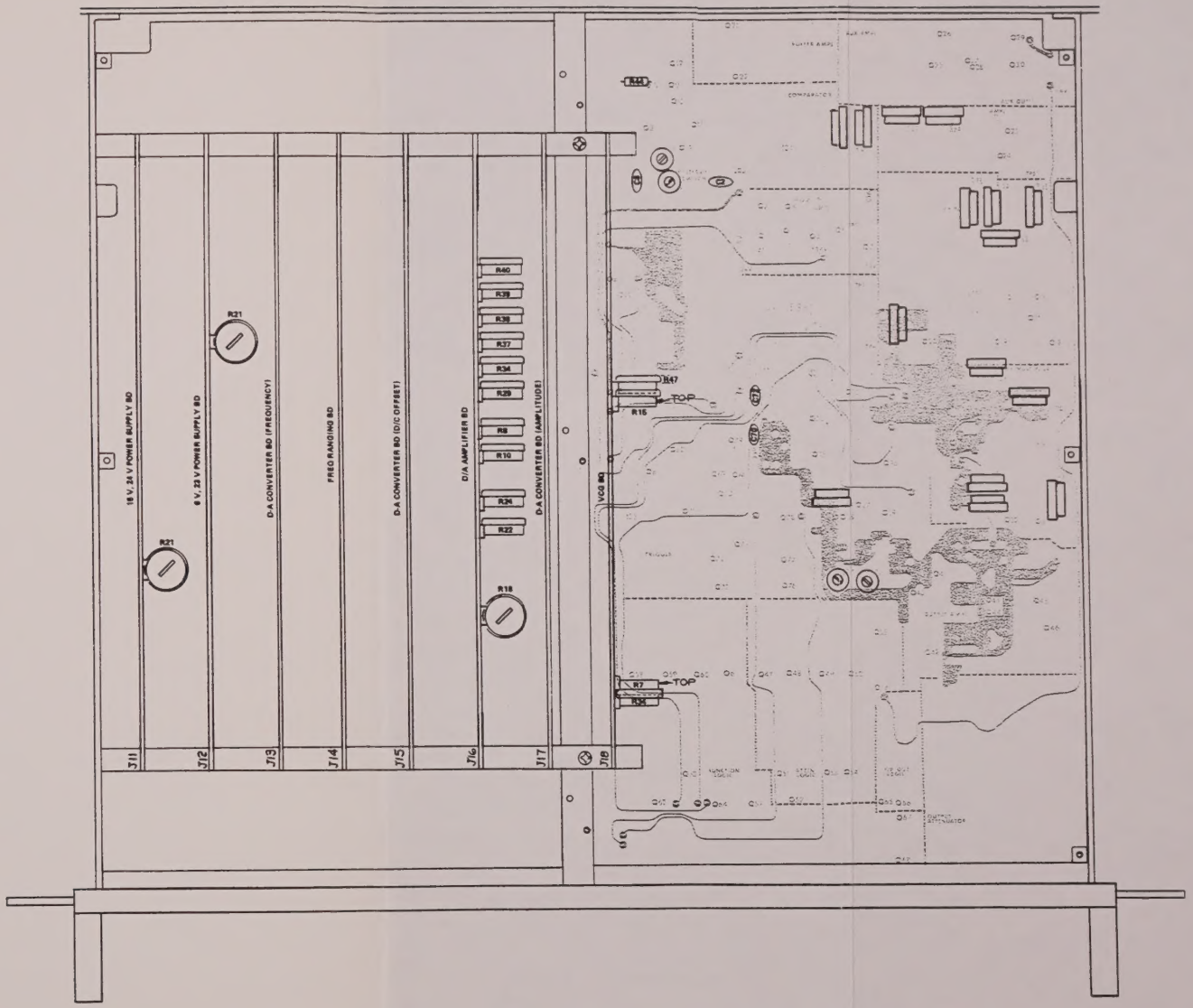
REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	EXTENDER	154-118	WVTK	1700-00-0088	1
1	CONN,EDGE CARD	252-18-38-160	CINCH	2100-03-0013	1
3 3A	STANDOFF	15318-3/8	USECO	2800-02-0002	2
5 5A	FAST,CHASSIS	1591-811	USECO	2800-09-0021	2

WAVETEK PARTS LIST	TITLE EXTENDER	ASSEMBLY NO 1100-00-0088 PAGE: 1	REV

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE EXTENDER BOARD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° XX ±.020		
	DO NOT SCALE DWG		MODEL NO 154 / DWG NO 1100-00-0088 / REV
	SCALE		CODE IDENT 23338 / SHEET OF



ADJUSTMENT AND TEST POINT LOCATIONS

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